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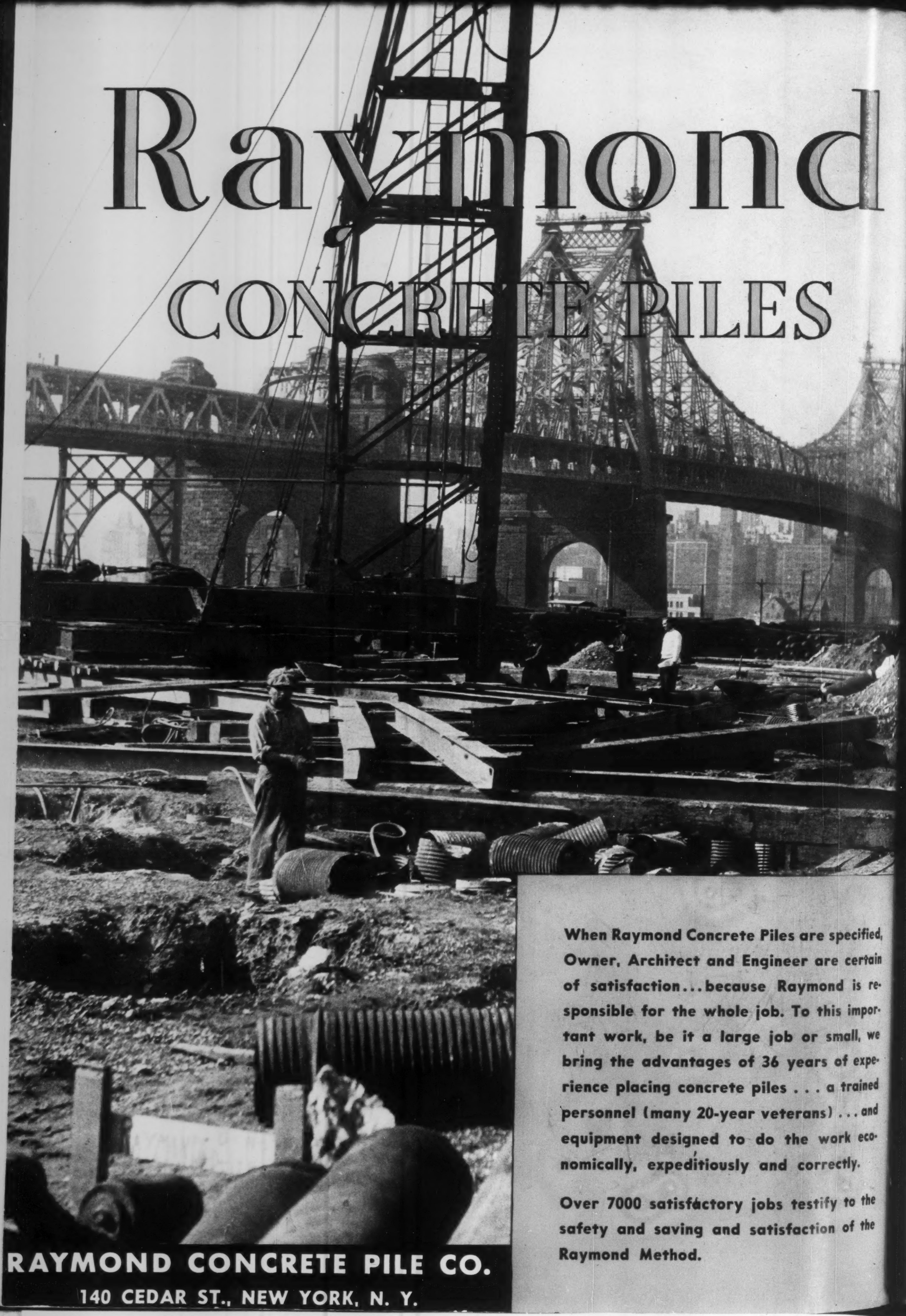

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Among Our Writers

R. E. Doherty (University of Illinois, 1909) became president of Carnegie Institute of Technology in 1936. From 1909 to 1931 he was with the General Electric Company, part of the time as assistant to Dr. Steinmetz. He went to Yale as professor of electrical engineering in 1931, and from 1933 to 1936 was dean of the school of engineering of that university.

Francis P. Sullivan has practiced architecture in Washington, D. C., for a number of years. He is active in the work of the American Institute of Architects, having served as its second vice-president and as chairman of its Committee on Public Works, and being currently the head of its committees on the national capital and on interprofessional relations.

Harold J. Gallagher, now serving as chairman of the Public Utilities Section of the American Bar Association, has also served his professional organization as chairman of its Committee on Commerce. A graduate of the State University of Iowa (1916), he did graduate work at Harvard and was admitted to the New York bar in 1919. He is general counsel for the receivers of the Seaboard Air Line Railway.

Charles Gordon Heyd was president of the American Medical Association in 1936–1937. He is a surgeon, director of surgery at New York Post-Graduate Hospital, and executive officer of the department of surgery of the New York Post-Graduate Medical School. He received the M.D. degree from the University of Buffalo in 1909, and the degree of Dr. Med. Science from Temple University in 1937.

Carlton S. Proctor (Princeton University, 1915) has just completed a term as Director of the Society and is chairman of its Soil Mechanics and Foundations Division. His firm (Moran and Proctor) has served as consultant on the foundations for many important bridges, and on dams, power houses, and buildings throughout this country and abroad.

Howard L. King has spent all his working days on tunnel projects in New York City, except for two years in Georgia. On the Montague Street and Holland tunnels, he was employed by the State Commission. Since 1928, he has been associated with the Mason and Hanger Company.

A. J. Boase (B.S., University of Colorado; M.S. and C.E., University of Pennsylvania) was on structural and irrigation work in the Mountain States for several years; later taught structures at several schools; and in 1930 was made regional structural engineer for the Portland Cement Association in the East. His present position with that organization dates from 1933.

Robert Moses has an A.B. from Yale, an M.A. in jurisprudence from Oxford, and a Ph.D. in political science from Columbia. In addition to being commissioner of the New York City Department of Parks and sole member of the New York City Parkway Authority, he is chairman of the Triborough Bridge Authority and head of four other bodies having to do with parks and parkways in the vicinity of New York.

A. T. Mitchelson, who became acting chief of the Division of Irrigation in July 1938, has been with that organization since 1914. He is the author of numerous reports and technical papers, notably U. S. D. A. Professional Paper 831, "Siphon Spillways for Reservoirs and Canals," and Technical Bulletin 578, "Spreading Water for Storage Underground."

C. L. Hall's entire professional career has been as an officer of the Corps of Engineers. Recent duty includes service as District Engineer at Rock Island, Ill., 1927–1930, and as District Engineer at Cincinnati, Ohio, 1932–1936. Colonel Hall was an official delegate to the 16th Congress of Navigation at Brussels in 1935.

Merrill Bernard, at present engaged in the general expansion of the hydrologic and flood forecasting services of the Weather Bureau, was in private practice in Louisiana from 1918 to 1934, and did special hydrological research for the U. S. G. S., 1934–1936, particularly in the development of the unit-hydrograph method. He has written extensively on this and related topics.

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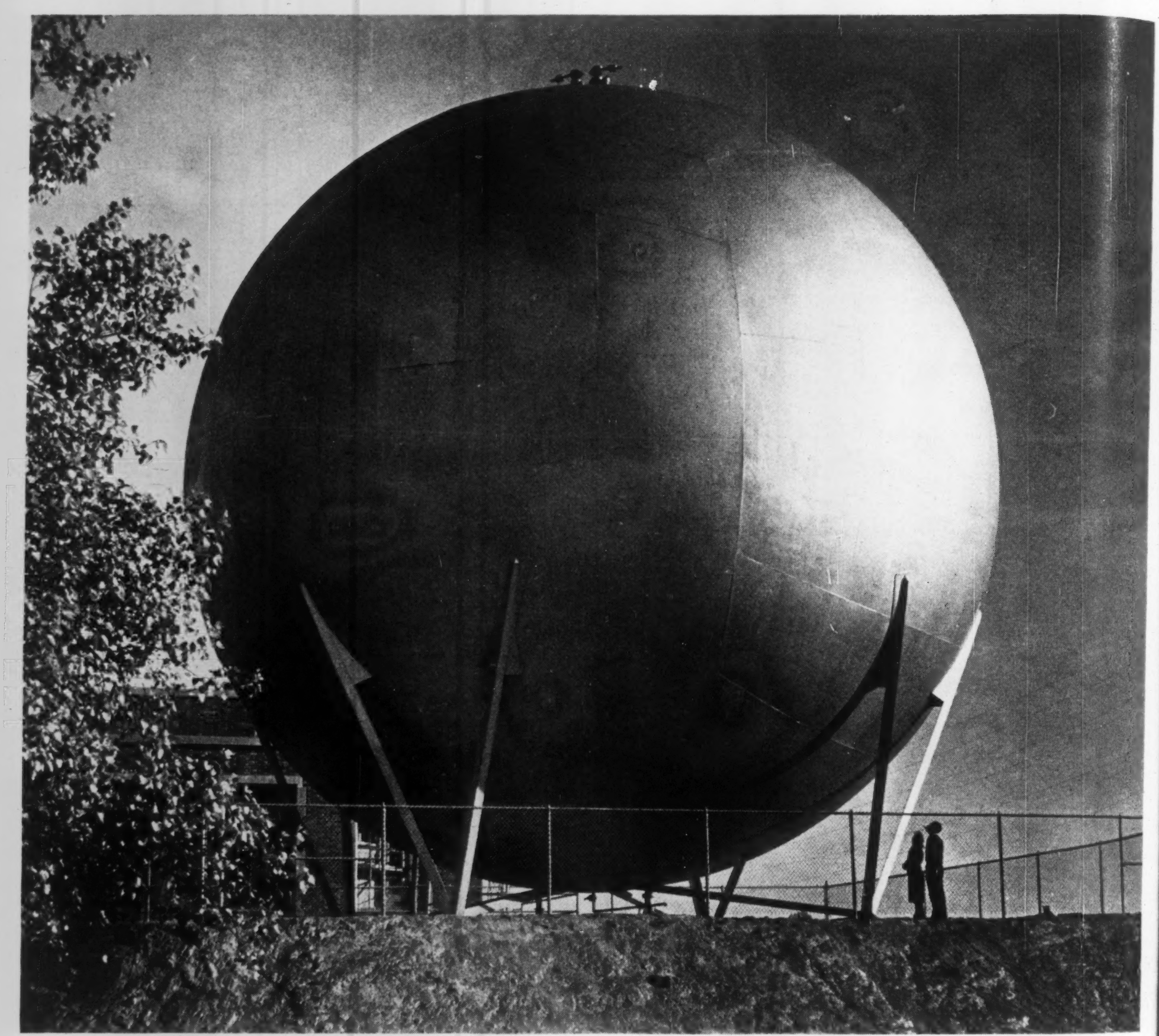

Pressure Storage at Sewage Disposal Plants

Facilities are installed at many sewage treatment plants to utilize the gas produced in the digestion process. In order to do this efficiently, it is often necessary to install a gas holder to iron out the irregularities in the supply.

The Hortonsphere is a desirable type of container for this purpose. It is relatively small in size and pleasing in appearance. There are no moving parts to require maintenance or water seals to heat. The shell of the holder does not come in contact with the sewage, eliminating discoloration and the need for frequent repainting.

The City of Cleveland has Hortonspheres at two of its three treatment works. The one illustrated above, holding 200,000 cu. ft. of gas at 39.9 lbs. per sq. in., supplies two 400 h.p. gas engines driving blowers that compress air for the aeration process. The cooling water and exhaust heat from the engines maintain the proper temperature in the digesters. In other cities sewage gas has been used to heat the plant and to generate power for pumping sewage.

When designing sewage disposal plants, check the advantages of using the gas produced in the digesters and get estimating figures on a Hortonsphere to provide storage. These economical high pressure holders are also used in gas distribution systems and at industrial plants to store gases or liquids.

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Something to Think About

A Series of Reflective Comments Sponsored by the Committee on Publications

The Paradox of Social Progress

By Robert E. Doherty

President, Carnegie Institute of Technology, Pittsburgh, Pa.

I PROPOSE to examine the significance of some current thought and trends in our social, economic, and industrial life. My primary emphasis will center upon the relationship which research, engineering, and education bear to social progress and welfare.

We are told by the economists that to maintain prosperity and social progress within the profit system, it is necessary continually to increase the efficiency of industrial production, that is, to produce more goods at lower cost. But this process, which involves the full power of science, invention, and engineering, increases rapidly the complexity of social organization; and even now that complexity is growing faster than our social understanding. Hence we face the paradox that this very improvement of production which would save us from economic and social collapse would apparently also impel us ultimately to the same tragic fate. In other words, the remedy and the ill seem equally fatal.

Is there any way out of this paradox of social progress? Can we afford to throttle engineering and invention and thus run the risks the economists would predict? If not, dare we encourage technological progress even at its present rate, let alone at an accelerated rate, and take the risks of social and economic confusion to which it is evidently leading us? What is the answer? It is planned education.

A Proposed Remedy.~My thesis may be stated in general terms as follows: I believe that this country faces a serious dilemma, with social confusion as the apparent outcome of either choice; that this dilemma can be resolved to the end of democratic ideals only by the long and difficult process of a planned education that will require some fundamental changes in policy; and that delay in such changes and in instituting a revamped educational plan may prove fatal to its success.

Let us understand the first premise. If an industry is operating in a balanced state—that is, if it pays its bills, its wages, and a reasonable dividend; if it keeps its plant and equipment in repair and provides those reserves which intelligent accounting control would specify; and if in doing these things it uses its whole income—then under this balanced state, the only way it can earn funds with which to meet any increase in expenditures, such as wages or taxes, is to produce its goods or service at a lower cost. If an industry is obliged, on account of government regulation, taxes, or the demands of labor, to destroy this balance, and is not able to meet the added cost by increased efficiency, then the ultimate result is bankruptcy. The railroads today are a good example. The coal industry is another.

Readjustments Demanded.~Then we face the compelling force of our second premise that science and engineering, which we would encourage, are rapidly increasing the complexity of social organization beyond our understanding. There would naturally be little satisfaction in building further the magnificent technological structure already begun, and upon it an increasingly complex social structure, only to have the whole affair tumble down upon us. Yet we seem to be headed toward such an outcome. In the councils of national concern, cunning and a froth of words take the place which reason and understanding should occupy. Witness the TVA controversy, the ill-fated NRA, the Supreme Court squabble, the conflict of labor with industry and with itself; and any newspaper will afford more examples.

But you may say that technology is not responsible for all of this—that congenital stupidity adds its share. Technology is responsible for a tremendously accelerated tempo of change. We are not, in this age, dealing with the creeping advance of a glacier; we are dealing with the dash of an airplane and the speed of light. And if we do not learn how to anticipate essential readjustments and to bring them about intelligently and with necessary promptness, we probably shall crash. That is the burden of our second premise.

If we accept these two premises, we are forced to the conclusion that our only hope is a planned education—an education that would cultivate social and economic understanding, humane appreciation, and a scientific attitude of mind. But I have no hope of Utopia. Even with such an education we should unquestionably still have our troubles. If we assume then that a planned education promises to be a way out, what form should this take?

Technological Education.~On the technological side the implications are clear. In the first place the student's program must be increasingly directed toward better understanding of fundamental principles of science and engineering, and toward greater ability in the processes of analytical and constructive thought. The miraculous developments of contemporary science and engineering are fruits of research, invention, and analysis that rested upon profound scientific knowledge. And future generations will go still deeper. Recognizing this, engineering education in undergraduate years must place more and more emphasis on fundamentals, thorough understanding, and constructive thinking; less and less upon details of subject matter and specialized skills. The latter can be learned in graduate work or on the job.

In proposing such change of emphasis I am not unmindful of the fact that many engineering graduates, perhaps the majority, will not participate directly in the pioneering side of scientific progress. They will be engaged in essential commercial and industrial activities for which a program cut out on the pattern of present curricula may be appropriate, but with the important exception that more time would be devoted to the social and economic side, which I shall now consider.

Social Education.~If the engineer's work creates wealth and physical comforts for society, but endangers social stability, then he ought to be more fully aware of what he is doing, its consequences, its dangers. His place in society has rapidly become a very important one. He has been literally flung into industrial management and has had to learn to deal with these new responsibilities while on the job and with no fundamental preparation such as he has had in engineering itself. On that side of management involving the cold facts of machinery, materials, and dollars and cents, I think we should all agree that he has been supremely successful; but not so on the human and social side.

His interest in social changes and his ability to understand them will not come by chance. As a student he must begin to cultivate this interest and ability. Then later when he encounters social problems he will at least have a start toward competency in studying them. One of the greatest educational fallacies I know is the assumption that the ability to solve problems in the field of physical science implies such ability in social and economic affairs. Indeed the reverse is probably true.

A Changed Curriculum?~How can the social side of the engineer's education be accomplished in a limited time? I am clear that it cannot be by offering electives in the conventional subject-matter courses. Even if the entire curriculum were assigned to such credit-hour units, thus eliminating engineering, I still should not believe that by this means the student could acquire an integrated, historical view of social development, the scientific attitude, and the ability to analyze complex problems in the field of social relations.

The approach to the educational problem should be an engineering approach. I would recommend for all engineers a four-year program, consuming perhaps a fourth of the total educational time, that would lead to the following outcomes: (1) a clear historical understanding of the parallel growths of science and engineering on the one hand, and social customs, relations, and institutions on the other, and of how these have reacted on each other; (2) the ability to read purposefully in order to make a critical analysis of a problem involving social and economic elements and to arrive at an intelligent opinion about it; (3) the ability to organize thoughts logically and with purpose; (4) the ability to use the English language and thus express those thoughts effectively; and (5) a continuing interest in all these matters—in other words, the desire to become educated.

Application to All Professions.~But I do not wish my thesis to become obscured by details of educational procedure. Economists tell us that chaos is inevitable unless technology is encouraged so that the efficiency of industrial production can be increased. Yet chaos seems equally certain if technology is encouraged, because it increases beyond our understanding the complexities of social relations and organizations. Our only hope, it seems, is a planned education.

The solution is difficult. Effective public understanding cannot be realized by a mere handful of broadly educated men; there must be not only those who serve the general welfare directly in their professional capacities, but untold others who, as citizens that have had the opportunity of higher education, will give critical thought and support to measures initiated for the public good. The education of such a professional citizenry is a long-range process. But there is a more fundamental difficulty. It is inducing mature minds to take a new view. Yet this must be done first of all, however great the task and the sacrifice. For the alternative price is infinitely greater—I mean the sacrifice of freedom.

Keeping the American Ideal.~There are certain things to which we must cling at all costs. We must keep intellectual freedom; we must keep individual personal liberty to the greatest possible degree; we must keep incentives to constructive effort. These tongue-worn phrases still symbolize the American dream. They represent ideals for which great sacrifices already have been made in life, treasure, and change of view. And it is unthinkable that as trustees of these gifts we should fail in the decision and action that would preserve them.

Will professional men not only in industry but also in politics, finance, and education, on all of whose shoulders this responsibility rests, act in time? Or will the ossification of view as we reach the age of professional decision prevent our taking the initial step that is necessary before the younger generation, yet in college, can have the opportunity to prepare itself? I have no fear that, given plenty of time, we should not reach the right decision; I do have fear that under the now greatly increased tempo of life we may wait too long.

This paper has been condensed for CIVIL ENGINEERING by Dr. Doherty from his address at the renaming of the Arthur Newell Talbot Laboratory at the University of Illinois. For the full address, reference may be made to *Electrical Engineering* for November 1938, Vol. 57, No. 11.

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Professional Status of Architecture, Medicine, Law, and Engineering

Committee on Professional Objectives Launches Its Program with a Survey of What Has Been Done in Other Professions and Studies Its Own Position

ON January 18, 1939, the general session of the Society's Annual Meeting was given over to a discussion of the professional, social, and economic status of the engineer. The program was in the hands of the newly organized Committee on Professional Objectives, and was designed to lay a broad foundation for its manifold activities. Accordingly it was, in large part, of a fact-finding nature. With this in mind, invitations to take part had been extended to the American Institute of Architects, the American Bar Association, and the American Medical Association—and an official representative of each was present to tell what these organizations have done to improve the professional status of their members. With these addresses as background, Carlton S. Proctor concluded the formal symposium with a paper analyzing the situation with specific regard to the civil engineering profession. These four papers are presented here. The formal discussions that followed them will appear as a second symposium in the April issue.

Professional Activities—Architecture

By FRANCIS P. SULLIVAN
CHAIRMAN, COMMITTEE ON INTERPROFESSIONAL RELATIONS, THE AMERICAN INSTITUTE OF ARCHITECTS, WASHINGTON, D.C.

TO describe what the American Institute of Architects has done to improve the social, economic, and professional status of the architect would be to write a history of the architectural profession in America. Whatever prestige and status the architect enjoys is the fruit of the seventy-five years of effort of that organization. It has created a profession out of what was partly a polite accomplishment, in which gentlemen used to dabble for their amusement, and partly a traditional craft handed down as a trade secret by mechanics.

It has built up a standard of professional conduct and has created a disciplinary code to enforce it. This code is in no sense a matter of form. The committees having charge of its enforcement are vigorous, alert, and disinterested, and no year passes without cases in which architects who have violated the canons are called to account and penalized.

It has established standards of fair compensation for the architect's services. As late as 1880 it was not an uncommon practice for prospective clients to ask for competitive bids on a price basis for architectural services, and the compensation paid in some instances for full architectural services was less than 1 per cent of the cost of the work. This practice has been completely wiped out. Competition among architects on a free basis is rare, and among reputable architects unknown.

It has been the sponsor of an educational method which has placed the architectural schools of America in advance of those of any other country in the world. The Committee on Education has been one of its most effective activities and it has been steadily at work over a generation collaborating with the schools of architecture to the end that their standard of accomplishment should be continually bettered.

It has encouraged and fostered research in building methods and materials. Through the efforts of the Institute there was created some years ago the Producers' Research Council, in which the manufacturers of the products used in building joined with the architects in the study of improved methods of manufacture and use of building materials, and wider and more effective distribution of technical information regarding them. The sessions of the Producers' Council are held each year simultaneously with the convention of the Institute, and the interest displayed in their proceedings is as great as in the sessions of the architects' own organization.

The American Institute of Architects has been responsible for the improvement of building codes throughout the country and the achievement of a certain measure of standardization in them which has resulted in the establishment of higher standards of safety and sanitation. It has written into the legislation of nearly every state in the Union provisions for the examination and registration of architects which require that anyone who undertakes to render architectural service must be qualified to perform it.

It has originated and published various standard forms employed in building operations including contracts, surety bonds, and insurance policies, thereby eliminating in advance many sources of misunderstanding and much unnecessary litigation. It has also established standard accounting methods resulting in a more accurate and thorough control by the architect over the business administration of building operations and greater security in the expenditure of his clients' funds.

Most of those activities which have any relationship to public health, public safety, improved public methods, or to the practical aspects of our work have been carried on in cooperation with the engineering societies, and where I have said that the architects have accomplished these things it would be truer to say that they have been accomplished by the architects and the engineers working in unison to a common end.

> *"For 87 years we have functioned almost exclusively as a technical society. This historic fact requires no explanation or apology; on the contrary, it is responsible in large part for the fact that the Society is stronger and healthier today than ever before .... But if we look carefully into our Constitution, we note that one of the objects of the Society is 'the professional improvement of its members.' And so today we are meeting the requirements of our Constitution in thinking of our professional improvement.*
>
> *"One of the most significant things about this meeting may lie in this start toward joint thinking about problems of the professional classes. Whether we are architects, physicians, lawyers, engineers, educators, or clergymen, we must acknowledge certain common fundamentals. A high degree of education for the professional man is taken for granted. His actions must comply with high ethical standards. His endeavors are largely devoted to service to his fellow men. He seeks respectability; and aspires to be deserving of respect. Finally, he desires a reasonably adequate compensation for his labors."*
>
> *—E. R. Needles, Chairman, Committee on Professional Objectives, in his opening remarks at the "Professional Status" symposium on January 18, 1939.*

As a result of these activities the architect has become every year increasingly better equipped to serve his clients and his community. With the raising of standards of practice in the profession the average level of intelligence, education, experience, and ability of the individual practitioners has increased, and with this increase in capabilities there has come a corresponding heightening of the architects' willingness to serve.

We find in the profession today an aroused social consciousness—a more acute sense of responsibility to the government and the public. The architect has come to see that the problem which he has to solve is not merely how he as an individual is to get his bread, but how provision is to be made for shelter for the human race. It is not enough that the residences of the rich achieve a degree of luxury unparalleled in the history of civilization, while there is a considerable fraction of our population which has not even the bare minimum of shelter. The means by which this discrepancy can be corrected is one of the matters to which our organization is now giving its most serious attention.

The work which the Institute has done has not been solely for the benefit of its own membership. In any controversy that arises, architects, whether they are members of the Institute or not, appeal to the standards of the Institute in order to determine what is right and just. This effort has been and must be a continuing one. There is no inch of progress that we have won in elevating the standards of practice or securing recognition of the professional status of the architect which we may consider definite and permanent. Once we have advanced to a position, we are then faced with a daily struggle to preserve it, for these ideals are under constant attack from within and from without.

From within, the attack comes chiefly from the younger members of the profession who, not conscious from their own experience of the reasons for the creation of many of the barriers and prohibitions the Institute has built up, feel from time to time that those barriers and prohibitions handicap them in their search for employment, and they would like to see them relaxed and liberalized.

But the most important service that the American Institute of Architects has performed for the profession and for the public which it serves is to maintain the status of the architect as an independent technical expert. It is the belief of our profession that its prestige, its influence, and its ability to render to its clients the highest type of service of which it is capable depend in great measure upon this independence.

The long-established custom of the building industry gives the architect a sort of semi-judicial status. It is his function to define and enforce the true intent and meaning of the building contract and in this capacity he must act impartially, protecting the interests and rights of the contractor as jealously as he protects those of his client.

To perform this function he must command the confidence of both parties to the contract and he cannot command this confidence if he is merely the agent and representative of one of them. Moreover, aside from the practical aspects of his work, he is practicing a fine art and the experience of past ages shows us that art can only flourish in an atmosphere of untrammeled freedom.

Of late years there has been an increasing tendency to destroy the independent status of the architect and reduce him to the position of a salaried subordinate employee. This is particularly marked in the field of governmental construction. Throughout the federal, state, and municipal governments, governmental architectural designing bureaus are continually increasing in number and growing in size.

It is the belief of the architects that the government is entitled to have, and its citizens are entitled to demand, only the highest type of architectural service in planning, design, and construction. And we believe also that except for one or two brief periods, government architecture as a whole has never reached a standard we consider worthy of it. Instead of being a source of inspiration and leadership to our profession, in only a few instances has it equaled the best work done for private use.

The largest and most important government bureau concerned with the construction of buildings is the Procurement Division of the Treasury Department. We have for some years been carrying on discussions with that department with a view to determining how the type of service proper for government architecture can best be obtained.

A joint committee consisting of representatives of the Institute and of the Treasury, after long deliberation, reported that the best architecture for the government can only be obtained by the employment of architects in regular private practice. This would seem to be conclusive; yet no action has ever been taken by the Treasury Department to put this recommendation into effect.

I believe we have been looking at the problem from too narrow a point of view. The real question at issue is not the relationship between the government and the architects, but the relationship between the government and professional and technical men as a class. In other words, the problem is: How can professional men best serve the government and the people?

The Institute is currently planning an "Interprofessional Conference" at which this problem and other topics of interest to the learned professions as a whole can be discussed. The present symposium, I believe, should be a helpful preliminary to that conference.

Professional Activities—Law

By HAROLD J. GALLAGHER

CHAIRMAN, PUBLIC UTILITIES SECTION, AMERICAN BAR ASSOCIATION;
MEMBER OF LEGAL FIRM OF MILLER, OWEN, OTIS, AND BAILLY, NEW YORK, N.Y.

FOR some sixty years the organized bar of this country has been striving for mutual cooperation to improve the administration of justice and to promote the social welfare, professional standards, and economic security of its members. When I speak of the "organized bar" I do not mean to imply that there exists in this country, as a whole, any comprehensive and self-governing organization of lawyers such as exists in England and in some continental countries. There are a great number of separate associations of lawyers, judges, and law teachers, and these collectively may be called the "organized bar."

In 1878 the American Bar Association was formed in Saratoga Springs, and it has been the largest and most influential body of its sort. For many years, unlike the American Medical Association, it had little relationship with the many local associations that sprang up, but since 1935 it has been reorganized as a truly national association representative of all the country's lawyers, although not more than approximately one-fifth of them are members. At the present time it has a membership of 31,735 lawyers and judges. Its policies are directed by a house of delegates composed of 177 members. Many of these delegates need not be, but of course most of them are, members of the association. Seventy-one of them represent the various state and territorial bar associations, and 14 represent local bar associations. Then there are official delegates from each of the 52 states and territories, and a number of representatives-at-large and ex officio members. The American Bar Association is now in a position to speak with a single voice for all the lawyers of the country.

Among other associations of national character may be mentioned the American Law Institute, which has for some years been engaged in the restatement of the law; the American Judicature Society, which has the aim of improving the administration of the law; the National Association of Attorneys General; the Commissioners of Uniform State Law, who have been trying, with a considerable degree of success, to eliminate the archaic situation which checkerboards our country into some 52 different legal systems; the Association of American Law Schools; and the National Conference of Bar Examiners. Altogether there are 31 voluntary associations of national character with a total membership of 42,524.

The various state and territorial bar associations include in their membership a little more than half of all the lawyers in the United States—83,929 members. There are about 1,000 local bar associations, more or less active, with a combined membership of 118,600.

Most of these associations are completely voluntary in their character. They have little or no official standing, and no disciplinary or other powers so far as the bar, generally, is concerned. The movement is rapidly gaining headway however, for the so-called "integrated state bars." In 18 states every lawyer, either by statute or by judicial rule, must be a member of the state bar organization. These integrated state bar organizations are, generally, given a broad power to govern lawyers and a broad responsibility for self-improvement and regulation, which in the other states has been left to the rather haphazard activities of courts and legislatures.

It is of these numerous associations that I speak when I refer to the "organized bar."

ETHICS AND ECONOMICS INTERDEPENDENT

The organized bar, particularly during the present century, has been making sustained efforts to face and solve the problems of how to improve the position of the lawyer in the community, the professional standards of the individual lawyer, and his economic security. These three aims are absolutely interdependent. The lawyer cannot be respected in the community unless his professional standards are high and unless he attains some measure of economic safety; lamentably often his standards of professional and civic morality are dependent upon his freedom from the pressure of poverty.

One of the principal problems which the organized bar is studying and attempting to remedy is the possibility that the bar is overcrowded. An enormous number of new lawyers are admitted to the bar in each year. According to the 1930 census, there were approximately 160,000 lawyers in the United States, equivalent to one lawyer for each 764 individuals. During the ten years from 1920 to 1930, while the population increased 16 per cent, the number of lawyers increased 31 per cent. Statistics gathered by the National Bureau of Foreign and Domestic Commerce, Division of Economic Research, in 1935, indicate that between 1929 and 1934 the total number of lawyers in the country increased nearly 24 per cent. The number of consulting engineers decreased during the same period by 10 per cent.

Without knowing the particular facts with regard to the requirements for legal service in each state, it is hard to generalize on the problem of whether or not the bar is overcrowded, but the bar associations are making studies to determine whether it is, and whether that condition is responsible for economic distress in the profession.

Great efforts have been made to improve the quality of persons admitted to the practice of law. The public is entitled to demand the elimination of the unfit, and the bar recognizes its responsibility in this direction.

In the early days most lawyers were trained in law offices. They acted as apprentices to members of the bar. It is only within the last 25 or 30 years that the practice of training lawyers in law schools has become recognized as the only proper method of professional preparation. As a result of campaigns of education conducted by the American Bar Association and various local bar associations, the public has been convinced that they have an interest in insisting that lawyers be properly trained. The problem was more difficult than in the case of doctors. The general public easily understood that it was important not to have poorly trained doctors but there was a public attitude that every one should be permitted to practice law with a minimum of prerequisite requirements.

SPECIFIC PURPOSES OF SOCIETY'S COMMITTEE ON PROFESSIONAL OBJECTIVES

1. To supplement and strengthen the work of the Board of Direction and the special committees of the Society.

2. To concern itself actively with subjects incident to engineering practice in order to develop and maintain high standards of practice and ethics, promote understanding among engineers and between the profession and the public.

3. To provide an agency through which both salaried and employer engineers may express themselves more freely and effectively on professional matters.

4. To give general consideration to national and state legislation affecting the engineer.

5. To give particular consideration to the economic and social status of the engineer and to national and social trends affecting him.

6. To encourage and demand a wider employment of engineers in engineering and technical works.

Beginning in 1921, the American Bar Association took a definite stand actively to support a movement requiring stricter standards for admission to the bar. Slowly but steadily, this movement has gained in strength and in leadership. It is becoming recognized generally that the practice of the law is a privilege rather than a right, and that the public interest requires that lawyers, in order properly to equip themselves to meet the complex legal problems of the day, must have a broad prelegal education as well as a thorough legal education. As a result of the efforts, principally of the American Bar Association and its committees and Section on Legal Education, legislation or court rule in 38 states and the District of Columbia now requires at least two years of college or its equivalent before admission to practice. Thirty-nine states and the District of Columbia require at least three years of law study, and rules have been adopted in more than half of the states requiring four years of study in part-time law schools.

The Association is seeking to eliminate the unqualified law school, the "diploma mill," the proprietary law school run for private profit and for the sake of their tuition fees, flooding the country with ill-equipped aspirants. The American Bar Association has adopted certain standards with which all law schools must comply in order to receive its "approved" rating.

Out of 185 law schools in the country, 97 are "approved" and 88 "unapproved." Over two-thirds of the law students of the United States study at the approved schools. In 22 states, graduates of unapproved schools are not eligible for admission to the bar. This is one very great accomplishment of the organized bar.

The Section of Legal Education and Admission of the Bar of the American Bar Association employs a competent man as an advisor, and through the trips of inspection made by him and other members of the council of the section, constant surveillance is given to see that the standards are met by schools before being put on the approved list and that they are maintained by schools which have been previously approved.

Another forward step has been accomplished by the cooperation of the American Bar Association with the National Conference of Bar Examiners, founded in 1931. For many years one of the principal problems confronting the candidate for admission to the bar was that his legal education did not prepare him to pass the bar examinations prescribed in the various states. The law schools, following the lead of Harvard and Columbia, had adopted a so-called "case system" which sought to train the law student to know how to approach legal problems—that is, to teach him general legal principles. The bar examinations, on the other hand, sought to inquire as to the candidate's knowledge of local law and procedure—largely a matter of memory. Through the joint efforts mentioned, the two points of view are gradually being brought closer together. Most bar examinations now examine the general qualifications of the candidate rather than his mechanical memory.

The bar associations have not stopped with pre-admission education, but have been promoting advanced legal education for practicing lawyers as well. Short series of lectures dealing with modern developments on subjects of current interest in the law have been sponsored by local associations and successfully held in many cities in the country.

EXCLUDING THE MORALLY UNFIT

Educational fitness is one aim of the organized bar. Moral fitness is another. Various methods have been adopted to exclude the morally unfit. Character committees exist in most states—sponsored by the bar or by the courts at the behest of the bar. In New Mexico a probationary period of practice is prescribed; in Pennsylvania a "moral precentor" must supervise the entire pre-admission law study of the candidate. Clerkships in law offices must be served prior to admission in many of the states. While, of course, all this supervision is not infallible, it is a step in the right direction. The various associations are untiring in their efforts to improve the quality of new lawyers.

These activities cannot fail to improve the standing of the lawyer in the community, but there has been increasing in late years what seems to be an organized campaign to bring the lawyer into disrepute. The bar recognizes this and is beginning to combat it. Radio programs have been devised to win public good-will. (Buffalo and St. Louis especially have found these helpful.) Efforts to cleanse the profession of its unworthy brethren have been publicized; efforts to eliminate the unauthorized practice of law by law agencies have been framed to emphasize the benefit of such elimination to the public rather than to the lawyer.

The radio and press campaign is in its infancy. The effort to cleanse the profession is older. This problem of the unworthy lawyer—one of the principal causes of popular distrust—is being vigorously met. Forward-looking lawyers appreciate that one scoundrelly lawyer out of a hundred in the community can do more harm to the profession than can be cured by the upright conduct of the ninety-nine, and they have been alert to practice surgery as well as preventive medicine on the unfit.

Discipline and the elimination of the dishonest lawyer are generally, in this country, within the jurisdiction of the courts, but the courts do not act of their own motion. Haphazard complaints against lawyers to the courts by persons aggrieved, while occasionally successful, did not scratch the surface of the problem. As various state and local bar associations came into being, each one has been implemented with a committee on professional discipline, usually called a grievance committee. These committees have generally been alert to weed out the unfit—not only those guilty of actual crimes, but also those guilty of violation of the principles of professional ethics.

Parenthetically, while various codes of ethics have been drafted from time to time, it was not until a meeting of the American Bar Association in 1908 that canons of professional ethics were adopted on a national basis. Since that time practically every state and local association has adopted the Association's canons. Committees have been active in each association to construe and elaborate on the canons and to answer inquiries as to what conduct may be proper and what improper.

The discipline committees have been hindered by a view very general in the profession, that professional misconduct should be overlooked if not actually condoned. Notwithstanding this obstacle, they have accomplished a great work. One, that of the Association of the Bar of the City of New York, spends over $20,000 annually in its work, maintains a paid counsel and staff of assistants, receives and investigates a vast number of complaints, and carries on the actual court prosecutions.

The American Bar Association has had a discipline committee only since 1924, and while its national character has prevented it from taking the initiative in disciplinary proceedings that local associations have taken, its influence has been most salutary.

The bar has taken and is taking all precautions which can be devised to eliminate men who are intellectually or morally unfit to practice the profession. The task goes further than that. When once a young lawyer is admitted to the bar, if he is unable to gain a minimum living wage, he must be necessarily beset by temptation to abandon the observance of the principles of legal ethics. This unfortunate situation cannot be attributed to a lack of moral fiber on the part of lawyers generally. Young men are driven into these practices by the sharp impulsion of physical hunger.

A lawyer must spend upwards of five years in obtaining his preparation for the bar. When the candidate is ready for admission he is generally older than the average person starting out in business and he has a special training which would, within normal expectation, bring him a living wage. Perhaps three years of practice should ordinarily be regarded as the length of time necessary for a lawyer really to become a practicing lawyer. A recent survey conducted by the Special Committee on Economic Conditions of the Bar, appointed by the American Bar Association, shows that at the end of the third year of practice about a third of the young California lawyers and about a fifth of the young New York lawyers were earning less than $1,000 a year. Well over half in each state were earning less than $2,000 a year.

The smallness of legal income does not stop with young lawyers in their first three years at the bar. According to a survey of the Department of Commerce, the average net income of all the lawyers in the country in 1935 was $3,725.

PRACTICAL EFFORTS TO INCREASE EARNING CAPACITY

The bar itself is striving mightily to improve the situation. It is sponsoring vocational guidance in some of the states to urge young aspirants not so well fitted for the profession as others to seek other fields than the law. It is sponsoring movements to reduce overhead expenses of law offices by promoting the publication of cheaper law books and the simplification of legal procedure. It is encouraging large-scale cooperative offices where young lawyers can pool their stenographic and library expenses. Its attempts to improve earning capacity, incidentally, are not limited to the young and struggling lawyer (and to the older lawyer who has to struggle too), but extend to the entire legal profession.

The bar is also seeking to devise means for a more equitable distribution of work. It is trying to spread out political patronage to a greater extent and to make additional employment for young lawyers in legal aid societies and other public or semi-public projects.

One field in which the bar is being helpful to its members is that of unlawful practice of the law. I will not go so far as to say that the primary purpose of this effort is to increase the earnings of the bar, but it must necessarily have that effect, as well as giving protection to the lay public.

The various bar organizations have been increasingly active in suppressing the practice of the law by unqualified persons such as life insurance salesmen, notaries public, customs brokers, banks and trust companies, patent consultants, and tax consultants. In most instances these efforts have been accomplished in an amicable fashion by mutual agreement by the legal and lay organizations, each promising not to infringe upon the field of the other. Where a treaty is impossible, the bar associations have been alert to enforce or see to the enforcement of the criminal law, which makes it a crime in most jurisdictions for a person not admitted to practice to engage in the practice of law.

Professional Activities—Medicine

By Charles Gordon Heyd, M.D.

New York, N.Y.; Member, Council on Medical Education and Hospitals, American Medical Association

If the American Medical Association did not exist it certainly would be invented, for it came into being in response to the demands of society. The American Medical Association is composed of over 106,000 members. It is a federation or union of the several state medical societies, with the United States dependencies, under a central authority. This authority is brought into being by the election of delegates from each state and territorial medical association. These delegates assembled in a House of Delegates legislate on all matters of general polity.

The object of the American Medical Association is to advance the science and art of medicine and to promote public health. It is dedicated to a public service. The

American Medical Association was founded on May 5, 1846, under the inspiration of Dr. N. S. Davis of New York (later of Chicago) and in the next year delegates met at Philadelphia and promulgated a national code of ethics together with proposals on medical education. The first meeting was held in Philadelphia in 1848. In the 89 years since its founding, the American Medical Association has assumed functions and labors beyond the dreams of any of its founders.

> *"If we are thoroughly honest with ourselves, we will admit that we are but tilting at windmills when we place the responsibility for our present lack of status on any but ourselves."*
>
> *"With the training for architects, lawyers, and doctors requiring a basic undergraduate academic course in the humanities followed by a postgraduate professional training, are not the engineers obtaining but a glorified trade school training instead of a real professional education?"*
>
> *"It requires plenty of determination and fortitude to challenge the institutions of professional education; to force the abolition of competition for students between engineering schools; and to impose a strict self-discipline on the profession. But the fruits of such efforts are the objectives we seek."*
>
> *—Excerpts from the address by Carlton S. Proctor.*

For 150 years the industrial revolution has brought about tremendous changes in the population density in cities, increased productivity of farms, and a general betterment in the standard of living. At about 1890, when the frontier in America was definitely closed, medicine began to be incorporated into the entire life of the people and assumed great social responsibility. The rise of health departments, the almost complete extinction of typhoid fever, smallpox, and diphtheria, the phenomenal elimination of infantile diseases of childhood, the phenomenal lowering of the tuberculosis incidence, were accompanied by a significant change in the basic educational qualifications for the practice of medicine. There ensued, by almost imperceptible degrees, a complete reformation in the quality of medical education. These changes in education, which were so fundamental in their importance and so far reaching in their practical application, began with the creation by the American Medical Association of a Council on Medical Education and Hospitals.

In the middle of the nineteenth century medical education was frequently haphazard and crude; only a few colleges had organized teaching curricula. Of medical societies there were plenty. There were a few great and powerful medical schools, also many commercial proprietary and poorly equipped medical schools, organized and maintained for profit. With the formulation of the code of ethics and scientific assemblies, the main activity of the Association was to promote facilities for better medical education. In 1905 the Council on Medical Education and Hospitals was founded, and it became the chief agency for improving the quality of medical schools and thereby obtaining a more competent education of doctors. This council was concerned, among other things, with the following activities: (1) to consolidate public opinion in order to diminish the number of medical schools; (2) to raise the educational qualifications of medical schools into Class A schools; (3) to inspect and certify approved hospitals—hospitals that were approved for internship, hospitals approved for residents; and (4) more recently, the certification of specialists in the 12 major specialistic divisions of medical practice.

In 1905, there were in existence about 165 so-called medical schools, most of them proprietary. Under the influence of the organized public opinion created by the council this number was reduced to 65, with elimination of all proprietary schools.

With the rise of chemistry and the ability of chemists to displace certain atomic groups at will, it was apparent that a multiplicity of pharmaceutical commodities would ensue. It was necessary for some body of national importance to devise means of protecting the public from false, deleterious claims of therapeutic effectiveness and to keep the field of medical prescribing clean and respectable. The Council on Pharmacy and Chemistry was the response to this necessity. This council stands as a beacon light of truth between the public and the physicians and effectively prevents the exploitation of either group by commercial enterprises.

In a similar manner the multiplicity of instruments using electrical modalities made it imperative that standards be devised, definitions determined, and controls established to obviate dangers inherent in their use. Thus came into existence the Council on Physical Therapy.

Scientific discovery would be of no avail and its application to medicine would be impossible without three definite ancillary features: (1) the discovery must be evaluated in terms of clinical usefulness; (2) if proved efficacious, the information must be widely diffused; and (3) it must be made available for the treatment of disease, to lessen human suffering, or to promote health. For these particular functions the American Medical Association has the Council of Scientific Assembly and the Committee on Scientific Exhibit.

If that is essential in regard to the use of medicaments then the same measure of responsibility to the community with regard to foods would also be apparent, and thus one of the activities of the American Medical Association is the Council on Foods.

From the 48 states, Puerto Rico, Hawaii, Alaska, and the Panama Canal Zone, there arises a large number and variety of legislative enactments bearing upon the practice of medicine. The interpretation of these various acts requires a full-time staff of lawyers and technically trained assistants; hence the American Medical Association has its Bureau of Legal Medicine and Legislation.

Fully one-half of the funds of the American Medical Association are spent in public education, and it is significant that one of the most useful adjuncts to public education is carried out by the Bureau of Health and Public Instruction.

KEEPING TAB ON THE CHARLATANS

In most newspaper offices there is what is known as the "morgue." In this department is kept a comprehensive index with clippings and data on most of the distinguished citizens. Of more importance to the medical profession is an index of the irregular practitioners, the fakirs, the charlatans, the crooks, and one of the very extensive features of the headquarters office in Chicago is the Bureau of Investigation. The Bureau of Investigation is one of the educational activities of the American Medical Association, and has for its primary object the collection and dissemination of information on "patent medicines," quacks, medical fads, and various other phases of pseudo-medicine. It is a clearing house for information on the subject with which it deals. Federal, state, and municipal health officials, teachers in schools and colleges, physicians and others interested in public health refer inquiries to the Bureau of Investigation.

The Bureau collects its information through (1) original investigations, often supplemented by analytical work done in the Chemical Laboratory of the American Medical Association or in other high-class laboratories; (2) data received from federal sources (as the Food and Drug Administration of the U. S. Department of Agriculture, postoffice fraud orders, Federal Trade Commission) as well as from state and municipal boards of health; (3) information published in technical and other journals, both domestic and foreign; and (4) reports of special commissions, and so forth.

With the development of mass methods in industry came changes from the agrarian to the urban type of life. With the development of the automobile and good roads there came a change in the economic relationship of the doctor to society. The development of free clinics, free hospital services, free treatment clinics, changed in a great measure the usual sources of the physicians' livelihood. The diverse character of the economics of medicine in the different states, the large office maintenance expense of physicians in centers of population, introduced a multitude of conflicting factors. In the effective interpretation of these various movements, functions the Bureau of Medical Economics.

For the necessary research on food, pharmacy, and chemistry, the Association maintains one of the most complete, thoroughly equipped chemical laboratories extant. The instruments contained therein, particularly the recently acquired instruments for spectrochemical analysis, are in keeping with the policy of the American Medical Association to utilize the most modern equipment in chemical research problems.

From time to time there may be a difference of opinion in regard to juridical procedure or definitions of jurisdiction between local county units and state units, or perhaps differences between state societies. For this purpose, we have the Judicial Council.

This vast and complex organization which I have briefly described is administered in the interim between meetings of the House of Delegates by the elected general officers and the meetings of the Board of Trustees. At the annual meeting the 15 scientific sections, the Scientific Exhibit, and the Commercial Exhibit are devoted to the presentation of scientific papers, research data, and acceptable commercial products.

Professional Aims of the Civil Engineer

By Carlton S. Proctor

Member American Society of Civil Engineers

Consulting Engineer, New York, N.Y.; Member, Committee on Professional Objectives, American Society of Civil Engineers

This symposium may be of very real significance, or it may be merely another gesture towards the solution of problems of long standing in the profession. The answer lies largely with us and our willingness to face the facts of the situation.

Officially appointed representatives of the American Institute of Architects, the American Medical Association, and the American Bar Association have presented some of the background of the struggles with problems of economic and social betterment within their professions. I draw from these addresses the conclusion that in the case of none of these professions did its present economic and social status just happen, but with each a stern self-discipline was required.

Now let us analyze the situation with regard to the civil engineering profession to determine just what it is we seek; what is wrong within our profession; and what we must do to achieve our objectives.

These objectives seem to me to be, broadly, increased and steadier employment, better compensation, improved standing in the community as professional men, and the employment of engineers in the management and operation of engineering works and in the fabrication and manufacture of engineering products. The English have summed up all these desired objectives in the one word "status." In the November 4, 1938, issue of the English technical publication, *Engineering*, I find the following editorial statements:

"The relatively rapid emergence of engineers as an effective molding force in the land has engendered, of late, a widespread dissatisfaction that they have not succeeded in emerging, with commensurate rapidity, as leaders of the many commercial enterprises to which their efforts have given rise. Associated with this claim to self-determination is the complaint that the individual engineer, for all that he is so necessary to the maintenance of modern civilization, still lacks 'status' by comparison with the members of older professions and with the administrators who control the undertakings that he has made possible. . . .

"This is not to say that the elusive 'status' is also completely illusory; but there are, we submit, good grounds for questioning whether a more obvious ascendency of engineers in active government or commerce would contribute materially to the public respect for the engineering profession as a whole, which is the presumed meaning to be attached to the word 'status' . . . .

"There appears to be, however, another fundamental defect, common to nearly all of the schemes that are propounded from time to time for the improvement of status, namely, an insufficient appreciation of the nature of the distinction that is so assiduously sought. Status, as we see it, is something that can be conferred, but cannot be commanded; not, at least, the only kind of status that is really worth having. It is an indication of a spontaneous public opinion, and as such can neither be forced in its growth, nor synthesized from the components of a selected curriculum. The status that attaches to the professions of arms, of law, and of medicine was not acquired by making its attainment a deliberate goal, and can owe but little to the excursions of individuals from these professions into directive commercial or legislative offices, such as have long been whole-time occupations to those who have achieved any eminence therein."

If we are thoroughly honest with ourselves, I think we will admit that "status" does very well sum up our objectives, and that when we have obtained it, all the symptoms of economic, social, and professional worries will have been cured. And if we continue to be honest with ourselves we will admit that we are but tilting at windmills when we place the responsibility for our present lack of status on any but ourselves, or hope for an ultimate solution of our problems through any action other than our own professional self-disciplinary actions.

Mr. Sullivan has stated that the architects' status is the fruit of 75 years of effort by the American Institute of Architects, which has created the profession of architecture out of a combination of polite accomplishment and traditional craft; that the Institute has been the sponsor of an educational method which has placed the architectural schools of America in advance of those of any other country and that the architects have been steadily at work to assure that this standard of educational accomplishment is continually bettered.

Mr. Gallagher has explained the organized efforts of the American Bar Association to improve the educational standards of the profession; its efforts to show the public that the practice of law is a privilege rather than a right, and that the interest of the public and the profession require that lawyers have a broad pre-legal education as well as a thorough legal education. As a result of the efforts of the American Bar Association, legislation or court rule in 37 states and the District of Columbia now requires at least two years of college training as a prerequisite to legal education.

Dr. Heyd informed us: "In 1905 the Council on Medical Education and Hospitals was founded and it became the chief agency for improving the quality of medical schools and thereby obtaining a more competent education of doctors.

"In 1905, there were in existence about 165 so-called medical schools, most of them proprietary. Under the influence of the organized public opinion created by the council, this number was reduced to 65, with elimination of all proprietary schools."

PROFESSIONAL MAN CANNOT BE PRODUCED IN FOUR YEARS

The addresses of all three of these speakers bear witness to the basic fact that a stern self-discipline of their professions and professional educational standards has been exercised. All three of these professions realized years ago that a professional man cannot be produced in four years of educational training and that low educational standards inevitably result in turning out graduates in annual numbers far beyond society's and industry's ability to make places for them. All three demand that the educators of future members of their professions be themselves successful practitioners, capable of instilling into the minds of their students a wholesome respect for their chosen profession and of inspiring in them a genuine love and enthusiasm for their work.

Now contrast all this with the conditions obtaining in the engineering profession.

Recently, one of the leading deans of engineering told me that in his opinion most of our ills would be cured when the profession saw to it that only successful, inspirational instructors and professors were intrusted with the teaching of engineering students; that at present too many introverted failures were attracted by the cloistered life and relative wage security of engineering teaching, while unreasonably low pay and campus politics were keeping out the type of men most desired. Another equally eminent engineering dean recently blamed the competition between engineering schools for much of our difficulty, stating that in the scramble for students to fill 160 schools of engineering, standards of admission and performance are being constantly weakened.

With demands upon the engineer increasing daily and his needs for equipment to cope with leaders in all walks of life becoming daily more exacting, he is asked to assimilate a steadily increasing technical curriculum at the sacrifice of training in the humanities and cultural subjects.

No wonder the British editor complains that the engineer lacks status. With the training for architects, lawyers, and doctors requiring a basic undergraduate academic course in the humanities followed by a postgraduate professional training; with the standards of education rapidly rising for men in all walks of life; and with scientific and technological advancement and opportunities setting an unprecedented pace, are not the engineers obtaining but a glorified trade school training instead of a real professional education? Are not the young engineering graduates cursed with an inferiority complex when they come in contact with the more thoroughly educated men of other professions? And are they not confused in their minds as to whether they are in a profession or a trade? Is not all this recent agitation for unionization of engineers, and particularly the recently organized A.F. of L. Supervising Professional Engineers Union, highly symptomatic of our real trouble—a gravitation to the level of the most poorly equipped, and to the subprofessional, rather than a steady climb to the attainment of constantly increasing professional "status"? Surely the type of man who seeks a trade union to protect him in his work cannot be classified as a professional man. Definitely these demand the classification of tradesmen. Is it not high time that the American Society of Civil Engineers take a position of leadership in engineering education—selection of engineering teachers, and improvement of engineering schools? Is it not time we should agree that a professional man cannot be produced in four years, but that an accredited civil engineering training must be definitely postgraduate, with a broad undergraduate training as a prerequisite?

It is true that a few engineering schools are now opposing the general trend by attempting to place their schools of engineering on a parity with the schools in the other three professions. Several have for some years given a professional engineering degree only as a postgraduate degree. An example of the forward movement in this direction is found in the recently established course in "general engineering," leading to a B.S. degree and requiring a two-year postgraduate course prerequisite to a professional engineering degree, as now given by Princeton University. Here is found a liberal education forming the basis for a technical training—a comprehensive course of undergraduate study in the liberal arts, humanities, and social sciences to properly equip a professional man for his responsibilities and obligations to society.

THE DUTY OF THE SOCIETY

A voluntary new departure such as this by a few of our engineering schools, will of course provide the desired leadership for others to follow, but such an evolution will be far too slow to provide a solution to our immediate problems. The experiences of the three other professions demonstrate that the national professional society alone can bring about the necessary curricula changes. Only the American Society of Civil Engineers can exert the influence necessary to a broad national readjustment in civil engineering education.

It requires plenty of determination and fortitude to challenge the institutions of professional education; to force the abolition of competition for students between engineering schools; and to impose a strict self-discipline on the profession. But the fruits of such efforts are the objectives we seek. Only by making our profession worthy of "status," can we attain our aims.

Subaqueous Tunnel Construction

A Review of Modern Methods and Equipment

By HOWARD L. KING

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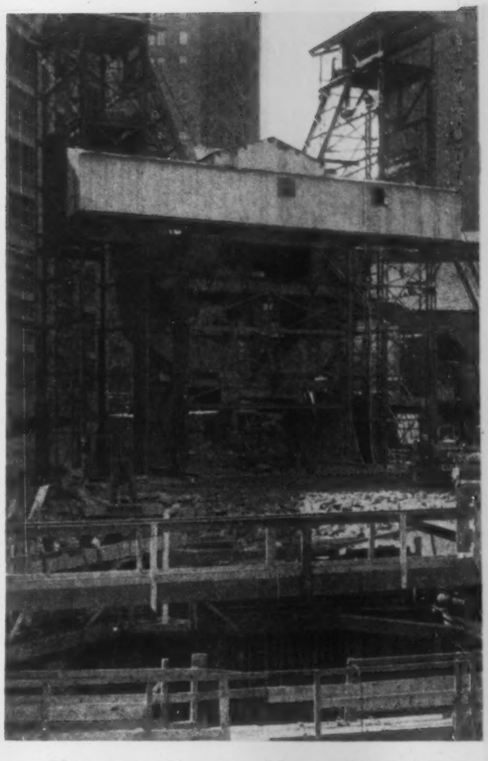


HEADFRAMES AND MUCK BINS, MANHATTAN SIDE, QUEENS-MIDTOWN TUNNELS
The Excavation in the Foreground Is for the Ventilation Shaft. Tunnel Construction Is Being Carried on Through Shafts Beneath the Headframe

ALTHOUGH this article is intended to discuss current practice rather than history, it will not be out of place to recall how recent was the first subaqueous tunnel in America. In 1879 De Witt C. Haskin started the pioneer work of connecting Jersey City and New York by a rapid transit tunnel under the Hudson River. The first plan was to use compressed air to balance the water pressure in the ground, and to line the excavation with brick. The work was interrupted in 1882 after a serious accident and because of lack of funds. In 1889 the project was revived, this time by the famous English contractor S. Pearson and Son. Shields were used and the tunnel was lined with cast-iron segments. After another interruption due to financial troubles, the work was completed under the direction of Charles M. Jacobs, M. Am. Soc. C.E., in 1905.

This early work was the laboratory in which many of the methods now used were developed. A goodly number of the engineers and construction men now connected with subaqueous tunneling had their first experience on this work or on the Pennsylvania Railroad tunnels whose construction followed immediately after.

In recent years, subaqueous tunnels have been constructed in increasing number in many cities and for various purposes. Although hourly wages in compressed air have risen sharply, this increase in cost has been offset by the increased skill of the workmen and by the use of machinery. Moreover, in many cases air is the only practicable method to achieve the ends desired.

Shields are used on all major projects to support the earth around the periphery of the excavation while the permanent lining is being constructed. On most projects, the type of lining is decided on by the designing engineers. Although structural steel lining is coming into more common use where conditions permit, and concrete block lining is sometimes satisfactory, cast-iron rings are preferred for under-water tunnels—where complete watertightness is an important objective.

WIDTH OF RINGS HAS BEEN INCREASED

Since the early use of cast-iron lining, the width of the ring in the direction of the axis of the tunnel has been increased slightly. On the first Hudson Tunnel, rings were 24 in. wide; on the East River subway tunnels, 26 in.; on the Holland Tunnel, 30 in.; and on the present Queens Midtown Tunnel they are 32 in. The width of the ring influences the design of the shield, affecting the length of stroke of the shield jacks, the length of the tail, and the distance that the hood projects beyond the cutting edge. Tapered rings, in which one face is slightly oblique to the other, are needed to effect changes in grade, to follow around horizontal curves, and to correct deviations from the true line and grade. Each ring is made up of a number of full-sized segments and a key. The length of a segment is between 6 and 7 ft (except when designed for erection by hand). Segments are interchangeable—except for the key and those plates that are next to it.

The outside faces of the flanges of all segments are carefully machined in the manufacturing process. Along the inner edge of all machined faces is a narrow calking groove. After the iron has been erected and bolted, a ribbon of lead is hammered into the calking groove to assure complete watertightness. Leaking at the bolt holes is prevented by inserting rings of hemp, soaked in red lead and linseed oil, under the washer at each end of the bolt.

Structural steel segments are manufactured strong enough and rigid enough to withstand exterior loads and stresses set up during construction. They are usually provided with longitudinal stiffeners between circumferential flanges to take the thrust of the jacks when the shield is being advanced. Bolt holes are prevented from leaking by the use of grommets as with cast-iron lining. The problem of making the joints between segments watertight has not been fully solved. Where the lining is erected in rock, the joints can be sealed effectively by welding, but where the tunnel is in wet ground the welding must be done under air pressure (which procedure would be hampered by a scarcity of skilled craftsmen), or against a certain amount of leakage after air has been taken off. A lead-calked joint has been proposed but has not yet been used. Structural steel lining is substantially less expensive than cast-iron both in manufacture and in erection.

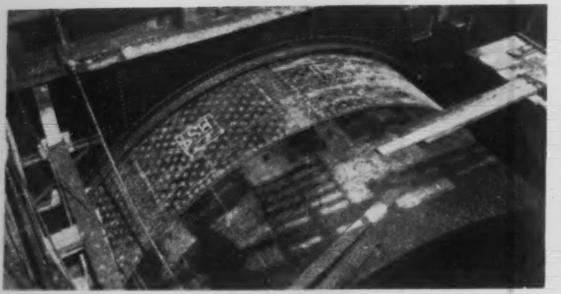
Concrete blocks have been used extensively to line tunnels in dry ground and also below the water level in silt and clay. When they can properly be used, they are more economical than metal lining.

Tunnel shields today are essentially the same as they were when Mark I. Brunel conceived and patented the idea in England over a hundred years ago. The basic ideas involved in the tunnel shield are as follows:

1. A shield must comprise a mantle or envelope covering the whole inside surface of the excavation and forming a protection under which the work of excavation can be carried on and the lining erected without the help of internal timbering.

2. It must have an internal stiffening structure of horizontal

THE accompanying article initiates a series on modern construction tools and practice that is planned ultimately to cover all the major types of project, large and small, with which civil engineers are concerned. Each article is being prepared by an acknowledged authority in the field it covers, and each will present a concise picture of up-to-the-minute methods that make for economy, efficiency, and speed in construction. Discussion of these papers by field men, with special reference to their own construction experiences, is particularly invited.



Starting the New York Shield on North Tube of Lincoln Tunnel

Work Was Begun from a Shaft Excavated Partly in Earth and Partly in Rock. The Shield Has Entered the Ground West of the Shaft; Its Tail, Which Is Still in the Shaft, Can Be Seen Just Below the Portal Girder. Several Rings of Tunnel Lining Have Been Built Inside the Tail

platforms and vertical partitions to support the envelope.

3. It must have a "tail," or a rear extension of the envelope, clear of any internal support, overlapping the tunnel lining already erected, under cover of which additional lining may be erected in short lengths.

4. It must have a means of forward propulsion, usually hydraulic jacks.

Starting from these basic principles, the shield designer must complete his work by adapting his details to the soil and other conditions to be encountered. How particular shield designs have been worked out will be discussed later.

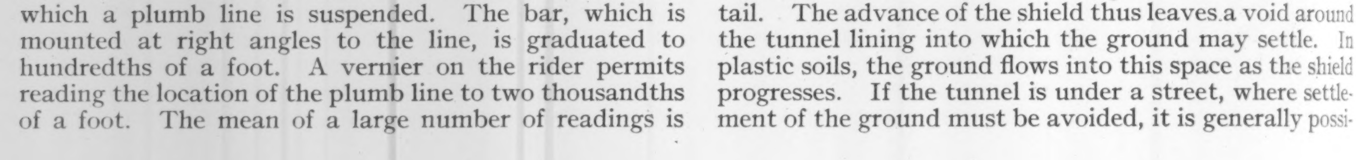
The problem of guiding the shield on the designed line and grade is one that is shared by the engineer and the contractor. The engineer must carry the line and levels from his base on the surface, down the shaft, and through the locks into the tunnel. Because of the importance of accuracy, this survey is repeated many times. A common method of recording the exact location of the line as found in each run is to use short lengths of brass bar attached to the tunnel lining at distances of about 150 ft along the approximate location of the engineer's line. Each bar carries a movable rider from which a plumb line is suspended. The bar, which is mounted at right angles to the line, is graduated to hundredths of a foot. A vernier on the rider permits reading the location of the plumb line to two thousandths of a foot. The mean of a large number of readings is used in prolonging the line. It is the usual practice to check the shield and the lining for alinement and grade after every "shove." Orders to govern the next shove are then issued to the contractor. The shield is guided by using those jacks around its periphery that will carry it in the desired direction.

In non-plastic soils, such as sand, gravel, and hard clay, the guidance of the shield is of primary importance. The iron must necessarily be permitted to follow the course taken by the shield. On the other hand, in plastic soils (as silt and soft clay) the engineer will need to concentrate his attention on the line and grade of the iron. The shield can be turned or tilted readily in silt.

In non-plastic soils, the lining should be built an inch or two above grade as it will settle behind the shield into the void left by the advance of the tail. In silt, the lining is built on grade or below grade as it has a tendency to rise behind the shield. This rise is due to displacement of silt ahead of the shield as the shield is shoved. The greater part of this displaced silt rises, forming a ridge or welt on the river bottom. Some, however, is forced rearwards under the shield and under the lining, creating a force that can easily lift the relatively light tunnel structure.

When shield driving in silt was started on the Holland Tunnel project, the rise of the back iron began to assume serious proportions. The problem was solved by taking in through the shield about 20 per cent of the total volume of silt displaced and leaving it in the invert as ballast until the shields had completed their journey.

It is obvious that the outside diameter of any shield exceeds the outside diameter of the tunnel lining by the thickness of metal in the tail plus the annular clearance between the exterior of the lining and the inside of the tail. The advance of the shield thus leaves a void around the tunnel lining into which the ground may settle. In plastic soils, the ground flows into this space as the shield progresses. If the tunnel is under a street, where settlement of the ground must be avoided, it is generally possi-


18' 10"
Traveling Jumbo With Movable Platforms
28–10" Hydraulic Jacks
Cutting Edge
Shield
Hydraulic Bulkhead Gates
Muck Conveyor
Shield
Mechanical Bolt Tighteners
2' 10"
Traveling Jumbo With Movable Platforms
Monorail Hoist for Handling Iron Segments
Iron Transport Car
Track on Flying Gangway
Muck Pile Left as Ballast
Monorail Hoist for Handling Iron Segments
Muck Conveyor
Erection Arm
Muck Conveyor
Iron Transport Car

LONGITUDINAL SECTION

CROSS SECTION
Rear View of Mud Dam

Fig. 1. Diagrammatic Picture of Silt-Tunneling Plant on the Lincoln Tunnel

Shield Is Closed Except for Two Gate Openings Through Which Muck Squeezes; Muck Taken in Is Deposited in Invert to Serve as Ballast Until Driving Is Completed. Tunnel Segments Are Brought in on a Track Hung on One Side at the Springing Line. Circular Track on Which Bolt Machines Travel Is Shown in the Longitudinal Section but Not in the Cross-Section ble to displace an appropriate amount of silt or clay at the face, which material will find its way around the shield to fill the void. In a stiff clay or in non-cohesive soil under a city street, the void must be artificially filled.

The method used to fill the void is to eject pea gravel through the grout holes of the tunnel lining as the shield is shoved and before the ground has had a chance to fall into the annular space. This operation is followed by ejection of Portland cement grout, which flows under pressure and fills any horizontal separations that may have opened up in the soil. Painstaking use of these two processes in conjunction with careful and skillful work in breasting down can be depended on to protect overlying structures from harmful settlement.

A shield in sand, gravel, or stiff clay, under a waterway, leaves the same void, but in this instance the only reasons for filling it are to check settlement of the tunnel lining, to afford lateral support for the lining so as to prevent spreading of the horizontal diameter, and to check loss of compressed air. The same gravel and grout processes serve here but are not fully satisfactory, especially as regards checking loss of air.

In the following paragraphs a number of recent subaqueous tunnels are discussed with special reference to new plant or methods involved.

East Boston Traffic Tunnel (built in 1932 by the Silas Mason Company for the Boston Transit Commission): This tunnel connecting Boston and East Boston under the harbor was excavated for the most part through stiff clay. The entire volume of earth had to be removed through the shield, there being no displacing of a part as in silt tunneling. The face was not breasted; such support as was needed was afforded by the movable shield platforms. Air pressure was generally under 25 lb. Structural steel lining was used.

A notable and successful innovation was the handling of the muck from the shield on conveyors through the tunnel bulkhead to the foot of the shaft and thence on a scraper conveyor to bins from which it was loaded into the disposal trucks. The loading ends of the conveyors at the shield did not have to be removed for erection of lining. Mucking was therefore a continuous operation. For passing the muck through the bulkhead, twin locks and twin conveyors were provided. While one lock was "in," its conveyor was being loaded; meanwhile the other lock was "out" and its conveyor was unloading. The operation of these locks and conveyors at the bulkhead was entirely automatic.

Lincoln Tunnel (built in 1934 and 1937 for the Port of New York Authority, by the Mason and Hanger Company): The Lincoln Tunnel comprises two cast-iron tubes, 31 ft in outside diameter, connecting midtown New York under the Hudson River with Weehawken, N.J. The south tube is now open for two-way traffic. When the second tube is completed, the south tube will be used for eastbound traffic and the new tube for westbound. The subaqueous tunnels were through rather soft Hudson River silt.

On the south tube about 20 per cent of the displaced volume was taken in through the shield. (On the north tube, built later, a somewhat higher percentage was admitted, to prevent displacement of the finished tunnel. The two tubes were spaced only 75 ft on centers.) This muck squeezed through two gate openings, each about 28 in. square, coming in like toothpaste out of a tube and falling on short conveyors that dumped it behind a muck dam which trailed the shield. This arrangement left the space immediately behind the shield clear of muck for the purposes of iron erection. The main features of the silt-tunneling plant are shown in Fig. 1.

The chief new departure on this job was the use of a mechanical bolt-tightener. This device, which is patented by L. F. Parker, was a labor saver and effected a uniformity in tightening bolts to any desired stress that could never have been achieved by hand effort. It consists of three parts—a hydraulic-powered cylinder, a carriage, and a mounting in the tunnel plant on which five machines can be installed. The piston of the cylinder grips an endless chain which turns a sprocket on a short shaft. This shaft carries a chock that fits over the nut of the tunnel bolt. The carriage, which is powered by two small air motors, provides the flexibility and movement necessary to permit the cylinder to reach any of the bolts on the ring that is being erected. The mounting consists of an I-beam bent into a circle and attached to the trailing jumbo that also carries the muck dam. The circular I-beam carries a gear track along which the individual bolt-machine carriages travel.

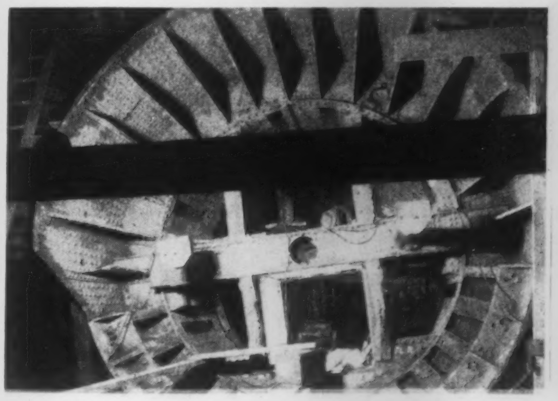
The suitable hydraulic pressure was determined by trial. A number of tunnel bolts were punch-marked and calipered. Micrometer measurements made after tightening these bolts under various hydraulic pressures revealed that 850 lb per sq in. would produce a unit tension of 50,000 lb per sq in. in the bolt. This hydraulic pressure was then adopted as standard. The hydraulic pumps and accumulator were located in the power house on the surface. The results obtained were so uniformly good that the customary retightening of back iron after the shove was deemed to be superfluous.

It is evident that it is in a tunnel in silt that a mechanical bolt-tightener is of most value. On the south tunnel, these machines (and other improvements in plant such as a new type of erector grip) made possible very rapid progress—1,042 lin ft in the best month. In sand or other material where the face has to be breasted down—that is, dug out ahead of the shield—and where all the excavated material must be passed through the shield, these machines would have to be mounted in some other way, and speed in bolting of the lining would be relatively less important.

Tunnels in Detroit: Within recent years a large number of tunnels have been driven for the city of Detroit for water supply and for interceptor sewers. The water tunnels have been excavated at depths of more than 50 ft below the surface. Some have been dug by hand mining, and in one, at least, a tunnel boring machine was used. The lining was generally concrete poured in place, closely following excavation.

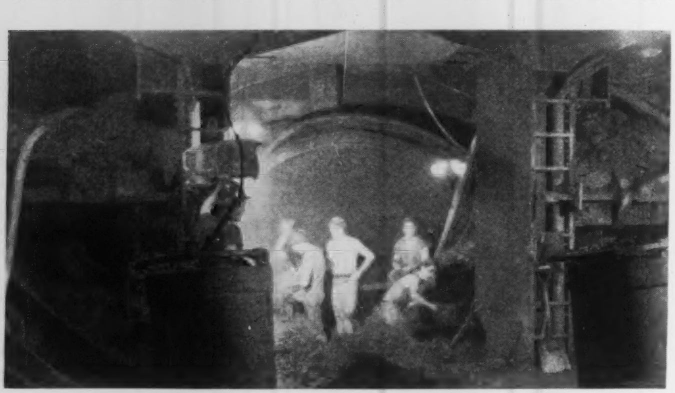
Tunnels for interceptor sewers have been driven under many streets. In some cases shields have been used and in other cases, hand mining. The linings used have been either steel plates or concrete blocks. One of the most interesting jobs was that done by the S. A. Healy Company of Chicago, in Jefferson Avenue.

Plans for this work called for a 16-in. monolithic concrete lining with a 16-ft interior diameter. The contractor chose to use a primary lining of precast interlocking concrete blocks of the type developed by the late John F. O'Rourke, M. Am. Soc. C.E. The blocks were 18 in. thick and 30 in. wide. They were kept in storage 28 days before they were used. A shield 22 ft in diameter was advanced by hydraulic jacks. The material was blue clay soft enough to squeeze through three openings in



Front View of Shield for Sixth Avenue Subway

The Shield Has Completed Excavation of East Tube and Is Being Dismantled for Reerection in West Tube. Lower Cutting Edge Is Made of Steel Castings, but Hood Is of Structural Steel the shield; all of the openings were above the springing line. The size of the openings was so regulated that the yardage admitted during each shove was a trifle less than the volume of the ring of tunnel built after the shove. Careful control of the amount of muck admitted was necessary to prevent settlement or heaving at the street surface. The muck was sliced off with wires as it came in, and thrown down into the waiting cars. After being hauled through the tunnel, cars were hoisted two at a time on cages and taken to a rollover car-dumper.



VIEW THROUGH THE LARGE CENTRAL POCKET IN ONE OF THE LONG ISLAND CITY SHIELDS

A Long Drift Has Been Excavated Ahead of the Shield. Most of This Drift Is in Rock, but Here Its Top Was in Soft Ground Supported by Liner Plates and Steel Ribs. These Will Be Removed as the Shield Pushes Forward

An erector on a separate jumbo trailed immediately after the shield for the erection of the concrete block lining. The placing of the monolithic poured-in-place lining followed from 300 to 500 ft behind the shield. Concrete was delivered through bore holes put down from the street surface. Both excavation and pouring of lining were performed under compressed air.

Progress was outstanding. An advance of 50 ft in a 20-hour working day was consistently maintained.

Queens Midtown Tunnels (now under construction for the New York City Tunnel Authority, Walsh Construction Company, contractor): The vehicle tunnel now (1939) being built between Manhattan and Queens under the East River is the largest tunnel through difficult ground that has ever been attempted in this country. The bed of the East River is sand, gravel, and clay, overlying mica schist and Fordham gneiss, and the rock surface is such that the tunnels pass in and out of rock several times. None of this muck can be displaced; it must all come out through the shield.

In ground of this character, it is necessary to use air pressure of practically the full hydrostatic head—and in a tunnel of large diameter this means a considerable excess air pressure at the crown, since the air pressure in the heading is obviously the same from the top to the bottom of the face, while the water pressure increases from top to bottom.

The "unbalanced air pressure" is restrained from lifting the cover by the submerged weight of the overlying material, and if the natural cover is not enough, it must be supplemented by adding a blanket of clay. It is generally considered that each 10 ft of cover is good for 3 lb of unbalanced air pressure. Even after safe cover has been provided, there will be more or less blowing, because the air, prevented from lifting the roof en masse, is not prevented from leaking out through the interstices between the grains of sand and finding its way through the blanket or around its edges. The clay blanket being placed for the Queens tunnel construction has already exceeded what has been necessary on earlier jobs.

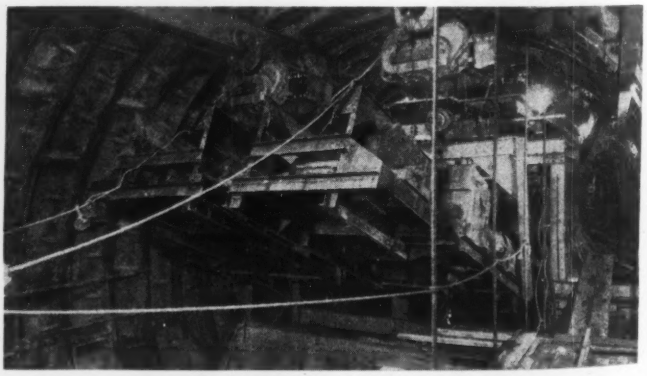
The most important innovation on the Queens tunnel work is the use of a Conway mucker at the shield. The conventional pattern of shield platforms and partitions has been modified so as to have a large central pocket extending from the level of the tunnel floor to the bottom of the heavy platform that carries the erector. One of these shields is shown on the cover of this issue. The miners start breasting down as soon as the shove is finished; the earth is dropped to the bottom of the breast; and the large pocket becomes partially filled. As soon as the erection of the ring is finished, the erector is hung up out of the way and the Conway mucker can start digging its way into the central pocket toward the face.

The Conway mucker is an electric-powered tunnel shovel that dumps its dipper load upon a short belt which discharges into a waiting car. In this installation, however, in order to reduce delay due to shifting of muck cars, the contractor has provided a belt conveyor to receive the muck from the Conway. This conveyor is long enough to permit the uninterrupted loading of a train of four cars. It is mounted on a carriage built like a shop crane to run on rails that rest on brackets on the iron at each side just below the springing line.

Shields for many years have been equipped with sliding platforms reaching out from the fixed horizontal platforms toward the face. After the face has been breasted down, these platforms, which are extended and retracted by means of powerful hydraulic rams, are pushed out against the "soldiers" that hold the breasting. Then, when the shield is advanced, these platforms or "tables" are allowed to come back slowly, supporting the breasting in a stationary position.

In moderate sized tunnels, this support of the face is often supplemented by struts carried back from the face through the shield pockets to a heavy cross timber called a "walking-stick," wedged into the completed and stationary tunnel ring in the tail of the shield. In a tunnel as large as the Queens tunnel, a walking stick would be impractical. To replace it, therefore, the Walsh Construction Company has introduced the use of a number of additional face jacks to furnish support to the breasting over and above that given by the tables.

The writer wishes to express his appreciation for aid received from John S. MacDonald and Herbert M. Hale, Members Am. Soc. C.E., and from L. V. Garrity, associate engineer of construction, Department of Public Works, Detroit. The historical information is from *Shield and Compressed Air Tunneling* by B. H. M. Hewett and S. Johannesson.



REAR VIEW OF MUCK CONVEYORS IN LINCOLN TUNNEL

This Plant Was Designed to Handle a Large Amount of Muck, Which It Might Have Been Necessary to Take in Through the Shield to Avoid Damaging the Nearby South Tube

Rigid-Frame Bridge on Findlay-Delphos Road in Putnam County, Ohio

Moot Questions in Rigid-Frame Bridge Analysis

By A. J. Boase

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Analysis of the double-span rigid-frame bridge involves a number of points that not all designers have yet settled satisfactorily for themselves. For example: Should one assume the bases to be fixed or hinged? Should sidesway be taken into account? Should the deck center line be considered as curved or straight? Mr. Boase's article supplies a practical, well-reasoned answer for each of these pertinent questions.

Recent developments show a definite trend toward the separation of traffic going in opposite directions by the building of dual highways. A group of two or more adjacent lanes provides for the traffic in each direction, but the lane groups are separated by a central strip with or without curbs along its edges.

Where a crossroad is to be carried over a dual highway, it is natural to provide a double-span overhead structure with a pier or bent in the central strip. The sketch of one-half of a grade separation structure over a dual highway in Fig. 1 illustrates a typical double-span symmetrical continuous structure of the type known as a rigid-frame bridge. The illustration shows three lanes and a sidewalk for traffic in each direction.

The anticipated increase in the use of double-span rigid frames in future grade-separation work makes it desirable to review briefly some moot questions in the analysis of the rigid-frame bridge. Some of these questions are more pertinent for double than for single spans, but in general the fundamental principles are the same regardless of the number of spans. The questions to be considered here are three: fixed versus hinged bases, sidesway, and deck curvature.

FIXED VERSUS HINGED BASES

The degree of rotational restraint exerted by the foundation upon the bases of rigid-frame bridges is uncertain. Some designers circumvent the uncertainty by analyzing frames, assuming first fixed and then hinged bases. Maximum moments, shears, and thrusts determined by the two analyses are then used for design of sections. It would save time if the designer knew beforehand which of the two assumptions is closer to actual conditions, so that only one analysis would be needed. This question will be discussed from both an analytical and an experimental viewpoint.

For the double-span rigid frame in Fig. 1, influence lines for moments at four points are laid out in Fig. 2. The influence ordinates are determined by the procedure of moment distribution applied to the center lines indicated by dashes and dots in Fig. 1. (The computations were made in accordance with procedures illustrated by numerical examples in "One-Story Concrete Frames Analyzed by Moment Distribution." Design constants were taken from "Concrete Beams and Columns with Variable Moment of Inertia." Both pamphlets are published by the Portland Cement Association.) Influence lines in Fig. 2 (*a*) are for the assumption of fixed bases, and those in Fig. 2 (*b*) are for the assumption of hinged bases. In each case, a curve is given for "no sidesway" and also for "sidesway only." The subject of sidesway will be discussed later.

Inspection of the curves marked "no sidesway" shows that the difference between fixed and hinged bases is practically insignificant as far as moments in the deck are concerned.

If sidesway is permitted, it is seen from the influence lines that the difference in moments at ends of deck spans may be quite noticeable. To illustrate, when load is placed at the outer third-point, the corner moment influence ordinate is 8.6 − 0.8 = 7.8 for fixed bases and 8.4 − 1.8 = 6.6 for hinged bases. When load is placed at the inner third-point, the influence ordinate for moment in the deck at the center support is 7.8 for fixed and 7.7 for hinged bases.

In this example it is seen that deck moments due to vertical loading are not changed greatly by a change in the assumption as to degree of moment restraint at bases. In general, the assumption of fixed bases gives conservative results for deck moments.

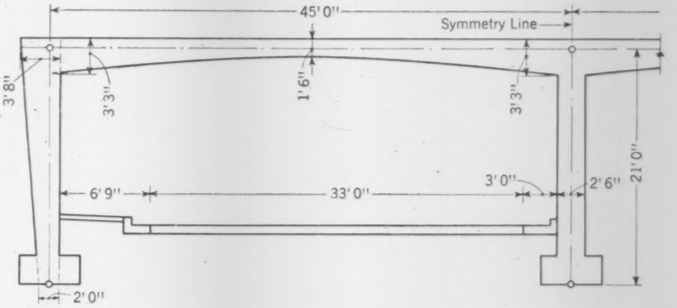


Fig. 1. Half Elevation, Symmetrical Double-Span Rigid-Frame Bridge

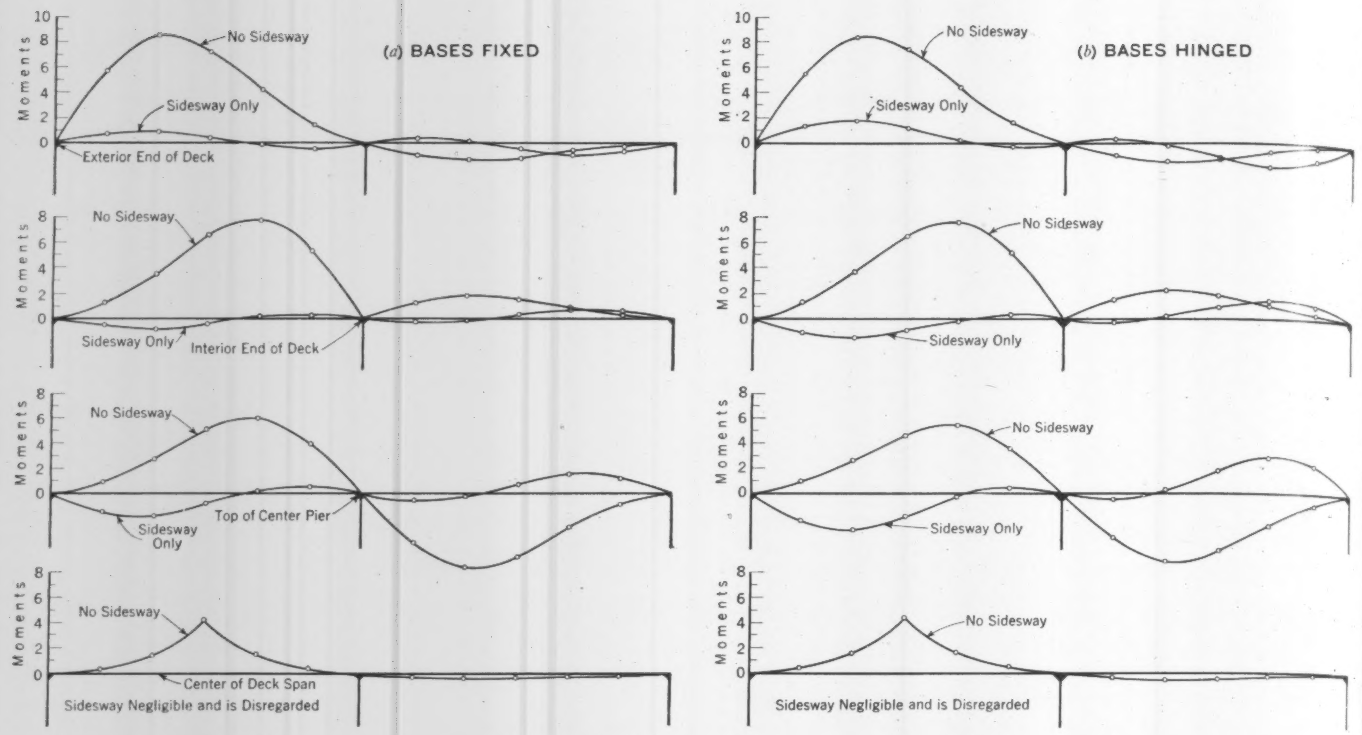


FIG. 2. INFLUENCE LINES FOR MOMENTS IN RIGID FRAME OF FIG. 1, FOR (*a*) BASES FIXED AND (*b*) BASES HINGED

In regard to deck shortening, including effect of shrinkage and temperature drop, a different situation exists. To illustrate, the moments caused by a unit deck shortening of 0.00066 in the deck in Fig. 1 are shown in Fig. 3, in which moments are given for both fixed and hinged bases.

Special attention is called to the moment of 116 ft-kips at the top of the fixed base. Since this moment is computed for a 12-in. width of frame, the theoretical value of $K = \frac{M}{bd^2}$ equals

$$K = \frac{12 \times 116{,}000}{12 \times (24 - 3)^2} = 263$$

The magnitude of the K value indicates how critical the moment may be at fixed bases in double-span bridges. For the example illustrated, the conclusion is that the degree of moment restraint has an important bearing on moments, shears, and thrusts caused by "deck shortening." Whether or not bases can be built to act as "fixed" is a question the answer to which must be based on experimental rather than analytical considerations.

Results of experiments made on single-span rigid frames with a theoretical span length of 48 ft have been published by Wilbur M. Wilson, M. Am. Soc. C.E., and R. W. Kluge, Assoc. M. Am. Soc. C.E. ("Tests of Rigid-Frame Bridges," *Proceedings*, American Concrete Institute, May–June 1938, Vol. 34, pages 625–648). The tests were planned and executed with the greatest care and with the best available laboratory technique. Considerable attention was given to moments at "fixed" bases. In some of the tests the bases were held exactly in the positions corresponding to full fixity, and yet the specimens consistently disclosed actual measured restraining moments that were much smaller than base moments computed by the elastic theory. The bases behaved as if they were only partially restrained.

After a great deal of study, checking, and additional experimental work, the reason for the discrepancy between measured and computed base moments was discovered. By the aid of sensitive bubbles and a high-powered microscope, a minute crack was located on a specimen above the fixed base. The crack was so small that even after having been discovered with the microscope, it could hardly be seen with the naked eye. The results of this study led Wilson and Kluge to conclude that "cracks near the bases of a leg reduce the moment at the base. . . ." The base itself was fixed, but a minute crack above the base permitted an angle change which sufficed to eliminate a large proportion of the theoretical fixity.

This conclusion is significant because it indicates that even extremely small angle changes—whether in the frame or in the foundation—are sufficient to cause large reductions in the fixity at the base. It is doubtful if bridge bases resting directly on top of subsoil can ever be considered as anywhere near fully fixed. And even bases on a pile foundation may be far from fully fixed.

The foregoing discussion illustrates another significant fact. While deck moments depend almost exclusively on load and dimensions, base moments are also affected to a considerable degree by deformations in foundation and by minute cracks. A deformation in the foundation or an undiscernible crack above the base of the leg will not affect the deck moments greatly but may cause a considerable reduction in the base moment. As a result, the actual base moments are unpredictable.

The situation might be confusing were it not for the fact that it really matters little how large the base moment actually is. If it is too large for the resisting moment provided, it is relieved instantly by a minor deformation around the base. Angle adjustments and moment reductions at bases do not endanger the load-carrying capacity of the structure as long as proper provision is made for thrust and shear.

It is believed satisfactory to design rigid-frame grade-separation structures on the assumption that the bases are hinged; to provide nominal reinforcement at both faces of the legs; to design the upper part of the leg for moment, thrust, and shear; but to design the lower part of the leg to withstand thrust and shear only. A positive mechanical hinge may do no harm but is seldom considered necessary. Integral construction is generally satisfactory, or a construction joint at the top of the base may be detailed so as to permit a slight angle change.

THE PROBLEM OF SIDESWAY

When a load is placed eccentrically on a free-standing rigid frame, the deck will move in its longitudinal direction. The frame is said to sway or be subject to sidesway. The deck does not sway when the load is placed over any one of the supports. In a bridge frame, sidesway is counteracted by several elements of construction including approach slab or steel rails, and embankment fill.

Since the actual condition of sidesway is uncertain, some designers make two analyses, one for each of the following assumptions: "sidesway prevented" and "sidesway permitted." Then they design the frame for the maximum values thus determined for moment, shear, and thrust. Whether or not this double analysis is required will now be discussed

Reference is again made to the influence lines laid out in Fig. 2 (*b*). If load is placed at the outer third-point, the corner moment influence ordinate for hinged bases is 8.4 for "sidesway prevented" but $8.4 - 1.8 = 6.6$ for "sidesway permitted," a reduction of 21 per cent. Deck moments at midspan, however, are practically the same for both assumptions.

It is obvious that neither one of the two limiting conditions, sidesway permitted and sidesway prevented, hold true in a grade separation structure like that in Fig. 1. All that can really be said with certainty is that the actual condition is somewhere between the two. If the bridge conforms to the assumption of no sidesway, the corner moment for a live load P is as high as $8.4P$; but on the other hand it may be as low as $6.6P$. Since it is not possible to predict the actual condition, the assumption that gives conservative results is preferable.

It should be mentioned that dead load and deck shortening cause no sidesway in a symmetrical frame, and that resultant moments generally are not greatly influenced by the choice of sidesway assumption. To illustrate, if live load stresses at a corner joint equal one-third of the total stresses, the "gap" between the two assumptions amounts to 21 divided by 3, or 7 per cent in terms of stresses. When the difference is so small, either assumption is acceptable.

CURVATURE OF DECK

Rigid-frame decks have cambered intrados, and the deck center line will be cambered also when it is drawn midway between intrados and extrados. The ratio of center-line camber to span length is small, however, and generally lies between $^1/_{50}$ and $^1/_{30}$.

One of the points frequently brought up is whether the deck center line should be considered curved or straight, and in case the straight line is considered acceptable, whether it should be taken through mid-depth of the crown or through mid-depth of the corner sections.

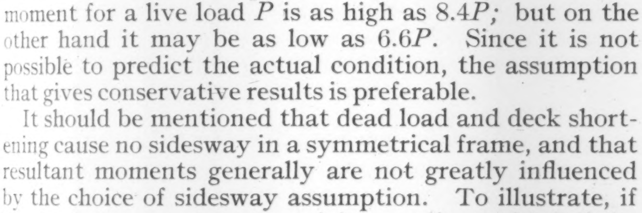


Fig. 3. Moments Caused by Deck Shortening

It is customary in rigid-frame analyses to disregard the effect of axial deformations. As a consequence, the distance between theoretical corner joints cannot be changed by application of vertical loading on a deck with straight extrados.

If the deck center line is assumed curved, a provision should actually be made in the analysis such as that indicated in Fig. 4, that is, spreading of corner joints should be prevented. When this provision is not made, the results of curved-line analysis will be in error. Therefore, it should not be taken for granted that the assumption of curved deck center line will give results that are necessarily more accurate than those obtained on the assumption that the deck center line is straight.

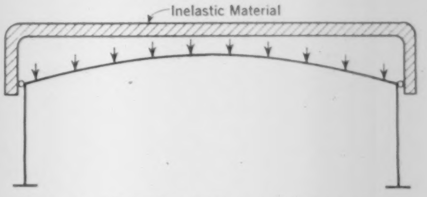


Fig. 4. In Analysis, Spreading of Corner Joints Must Be Prevented

If, however, the curved-line assumption be assumed to give the more accurate results, a close approximation can be made by the following analysis. Draw the deck center line as a straight line through mid-depth of the crown. Determine reactions at bases. Finally, compute all other moments, shears, and thrusts in the frame, using for this purpose the dimensions of the actual curved deck center line.

A study has been made by George A. Maney, M. Am. Soc. C.E., in which he analyzed a hinged rigid-frame bridge with a 65-ft span for four different cambers of the deck center line ("Analysis of Multiple Span Rigid Frame Bridges by the Slope Deflection Method," *Proceedings*, American Concrete Institute, 1936, vol. 32, pages 495–521). The four values of horizontal thrusts computed by standard arch analysis for a uniform load of 90 lb per lin ft are shown in Table I. The same four frames analyzed as just described, with a straight deck center line drawn through mid-depth of the crown, have the H values also shown in the table. Since the ratio of camber to span length seldom exceeds 0.03, the discrepancy in H for the bridge frames discussed is seen not to exceed 2 per cent. Discrepancies of this order are unimportant and do not justify the introduction of refinements in the analysis.

Table I. Illustrating Agreement in Horizontal Thrust, H, Obtained by Two Analyses

Camber in Feet	Ratio of Camber to Span	Horizontal Thrust, in Pounds, Computed by		Difference in Per Cent
		Standard Arch Analysis (Curved Deck)	Moment Distribution (Straight Deck)	
0	0	2,303	2,300	0
1.42	0.022	2,164	2,130	$1^1/_2$
2.84	0.044	2,035	1,970	3
4.26	0.066	1,926	1,840	$4^1/_2$

Attention should be called to an experimental fact in regard to sections at crown and bases. In interpreting the results of rigid-frame tests made at the University of Illinois, Professor Wilson and R. W. Kluge say that "an approximate determination of the moment at the crown and bases is satisfactory for purposes of design. . . ." In other words, designers need not be concerned about refinements introduced to give a high degree of accuracy in corner and base moments, as such accuracy is really only theoretical. It should be realized that discussions of crown and base moments are of academic rather than of practical value.

The Comprehensive Parkway System of the New York Metropolitan Region

By Robert Moses

Commissioner of Parks, City of New York, New York, N.Y.

In the New York Metropolitan Area there are now 325 miles of completed parkways, a 35-mile project currently under construction, and other similar improvements in the planning stage. To the development of this unparalleled arterial system no man has contributed more than Commissioner Moses, who is directly in charge of the Long Island and New York City parkways as well as the entire New York City park system. The present paper, in which Mr. Moses gives a general picture of the parkway system and describes a number of the interesting new design features, was on the Highway Division program at the Society's 1939 Annual Meeting.

Those of us who laid out the parkway program for the New York metropolitan region 15 years ago had no illusions as to the tremendous task ahead of us. The need for modern arteries of travel, including recreational facilities, had become a pressing and vital problem created by the sharp increase in motor car production and travel.

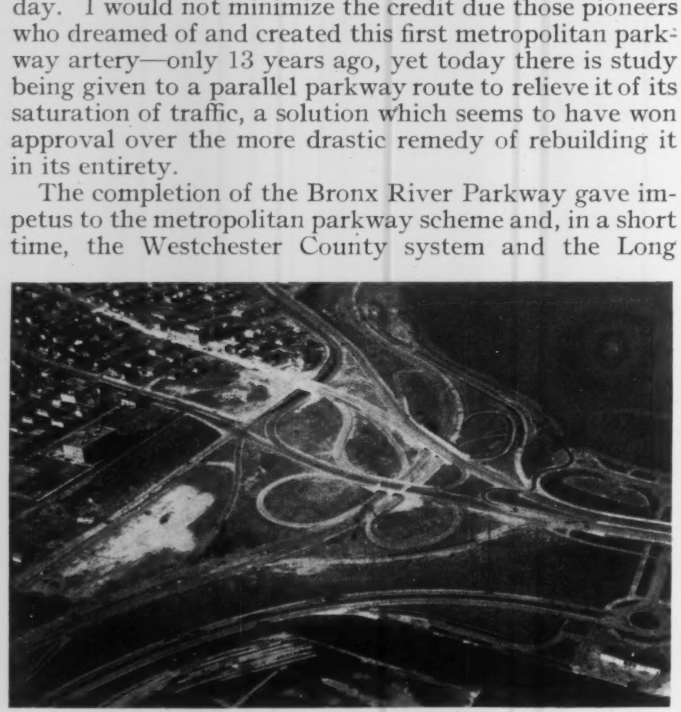
Today we are well on our way toward a sensible solution. The 325 miles of completed parkways in the metropolitan region (Fig. 1), including New York City and Westchester, Putnam, Dutchess, Nassau, Suffolk, and Fairfield counties; the Triborough, Henry Hudson, Whitestone, Marine, Cross Bay, and other bridge projects; the new 35-mile Belt Parkway project now under construction in Brooklyn and Queens; and other improvements being planned, have established a pattern for an unparalleled arterial system made possible by the cooperation of the federal, state, city, county, and other authorities who have provided the necessary lands and funds to carry these projects forward.

In 1925 the Bronx River Parkway was finally completed from Bronx Park to Kensico Dam. It had taken 13 years to build and was considered the marvel of its day. I would not minimize the credit due those pioneers who dreamed of and created this first metropolitan parkway artery—only 13 years ago, yet today there is study being given to a parallel parkway route to relieve it of its saturation of traffic, a solution which seems to have won approval over the more drastic remedy of rebuilding it in its entirety.

The completion of the Bronx River Parkway gave impetus to the metropolitan parkway scheme and, in a short time, the Westchester County system and the Long Island system through Nassau and Suffolk counties were being planned and built in rapid-fire succession. Curiously enough, the first metropolitan parkway, the Bronx River artery, had started in the city and worked its way out to the suburbs. This would seem to be the logical way of development, yet in the ensuing years the pattern developed in an exactly opposite manner, for while this program was being carried on outside the city's boundaries, planners were producing one scheme after another for taking care of this traffic within the city limits. Some were impractical, others over-elaborate, and others proposed such costly rights of way that they had to be tossed out of the window. It was not until 1929 that the Board of Estimate acted to acquire title for the Grand Central Parkway, the first right of way within the city limits, to carry the westbound traffic of the Northern State Parkway through Queens.

This picture of the city's indifference, however, is now changing. The pressure of parkway traffic dumped at the city's boundaries created a problem which is being solved by the development of a comprehensive system within the city itself. The Long Island Northern State Parkway has been extended by the Grand Central Parkway to the Triborough Bridge and by the Interborough Parkway to Brooklyn. The Southern State Parkway has been brought through the Laurelton and Southern parkways into Brooklyn. The Saw Mill River Parkway has been extended south by the Henry Hudson Parkway to connect with the West Side Elevated highway and to provide quick access to downtown Manhattan. Plans are now being drawn for the extension of the Hutchinson River and Bronx River parkways, the first to the Bronx-Whitestone Bridge and the second to Eastern Boulevard and Soundview Park, a comparatively short distance from the Triborough Bridge.

While the value of these radial spokes converging from the city's boundaries cannot be minimized, they are overshadowed by the important Belt Parkway now under way in Brooklyn and Queens, which will be completed July 1, 1940. This parkway, originally laid out by the Metropolitan Conference on Parks in 1930, has been advanced by a long series of limited objectives. The tunnel or bridge link from Manhattan to Brooklyn is still missing but is on the way. With this connection and the elevated connections from its Brooklyn portal to Owl's Head Park, and with the inevitable future tunnel under the Narrows to Staten Island and its connection with the Port Authority bridges to New Jersey, this parkway will become a major part of the great traffic belt around the city, connecting the West Side Improvement and Henry Hudson Parkway in Manhattan with the arterial system in Brooklyn by the tunnel, and with the Bronx by the new Bronx-Whitestone bridge. By the latter connection it ties in



Intersection of Grand Central Parkway Extension and Northern Boulevard

This Triple Clover-Leaf Is Adjacent to and Just West of the New York World's Fair. Flushing Bay Is at Upper Right with the parkway system in the Bronx leading to Westchester County, New England, and northern New York State.

Of course there are still great problems in the radials within the belt and much work must still be done on them to make the complete plan effective. However, much has already been accomplished. With orderly planning for the city's growth this problem is by no means insoluble, and the highway spokes which connect with the circumferential wheel rim should, in the not too distant future, become a reality.

These landscaped parkways, limited to pleasure vehicles, with their restricted frontage and without crossings at grade or traffic lights, have been proven not only to be the most efficient way of providing for the smooth flow of traffic, but also to be great neighborhood assets from the point of view of desirable residential growth, especially when provision is made for neighborhood playgrounds and for walks along side so that they can be enjoyed by local residents and pedestrians as well as by motorists. Where the parkways, with their attendant landscaping and provisions for recreation, pass through as yet comparatively undeveloped sections, they will determine the future character of the neighborhoods which will soon grow up along their borders.

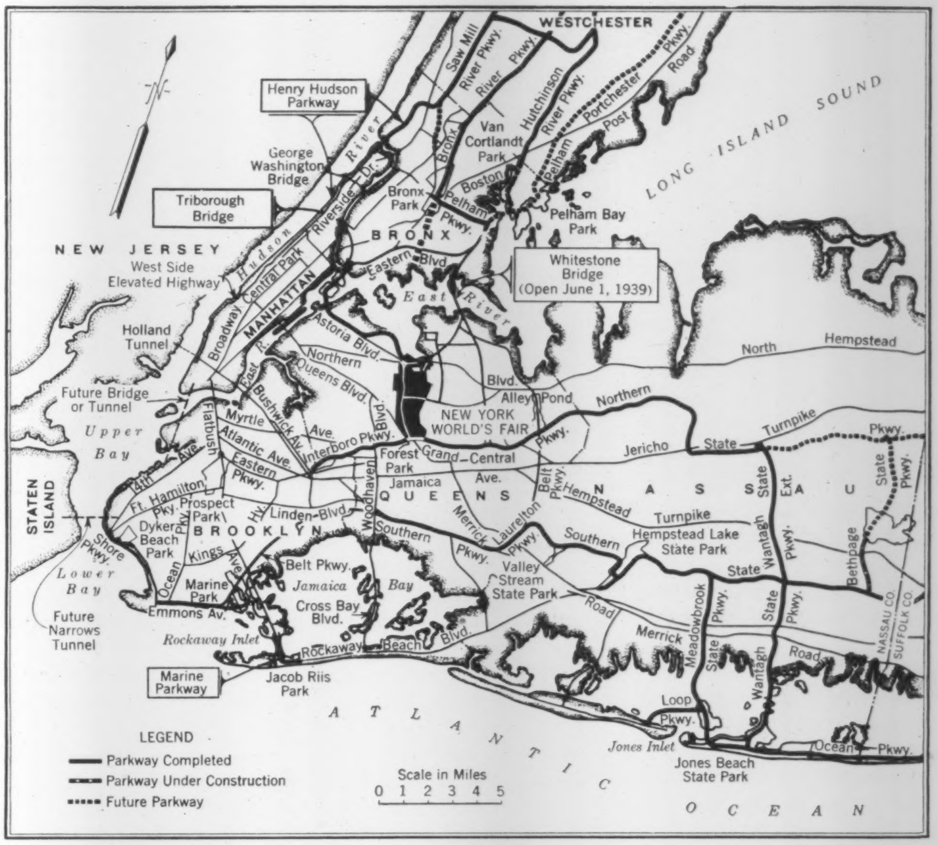

N
WESTCHESTER
Henry Hudson Parkway
Saw Mill River Pkwy.
Bronx River Pkwy.
Hutchinson River Pkwy.
Portchester
Post Road
Pkwy.
LONG ISLAND SOUND
George Washington Bridge
Riverside Dr.
Van Cortlandt Park
Bronx Pkwy.
Boston
Pelham
Pelham Bay Park
Triborough Bridge
Bronx Park
BRONX
NEW JERSEY
West Side Elevated Highway
Hudson River
Central Park
MANHATTAN
Eastern Blvd.
East River
Whitestone Bridge (Open June 1, 1939)
Holland Tunnel
Broadway
Astoria Blvd.
Northern
Queens Blvd.
North
Hempstead
Future Bridge or Tunnel
Bushwick Av.
Myrtle
Ave.
Blvd.
Alley Pond
Northern
NEW YORK WORLD'S FAIR
Upper Bay
Flatbush
Atlantic Ave.
Interboro Pkwy.
Forest Park
Grand Central
Pkwy.
Jericho
State
Turnpike
Pkwy.
4th Ave.
Eastern Pkwy.
Jamaica Ave.
STATEN ISLAND
Ft. Hamilton Pky.
Prospect Park
Linden Blvd.
Woodhaven
QUEENS
Belt Pkwy.
Hempstead
NASSAU
Turnpike
State Pkwy.
Ext.
Dyker Beach Park
BROOKLYN
Southern
Merrick
Laurelton Pkwy.
Southern
Hempstead Lake State Park
Shore Pkwy.
Kings
Hy.
Belt Pkwy.
Pkwy.
Valley Stream State Park
State
Wantagh
Bethpage
Lower Bay
Ocean
Marine Park
Jamaica Bay
Cross Bay Blvd.
Road
Meadowbrook State Pkwy.
Future Narrows Tunnel
Emmons Av.
Rockaway Inlet
Rockaway Beach Blvd.
Merrick
Road
NASSAU CO.
SUFFOLK CO.
Marine Parkway
Jacob Riis Park
Wantagh State Pkwy.
Loop Pkwy.
ATLANTIC OCEAN
Jones Inlet
Ocean Pkwy.
Jones Beach State Park
LEGEND
Parkway Completed
Parkway Under Construction
Future Parkway
Scale in Miles
0 1 2 3 4 5

Fig. 1. Map of New York City and Environs, Showing Parkway Developments of Recent Years

DESIGN FEATURES OF THE PARKWAYS

So much for the general parkway picture in and around New York City. While I realize that engineers are interested in the general view, I know that, as a technical group, they are also interested in some of the details that come up in connection with solving the manifold problems. I lay no claim to being an engineer. But fortunately I have been able to have a loyal, efficient staff of engineers associated with me in that part of the system with which I have had to do. I cannot help but know some of their problems and will discuss them in my own unscientific and non-technical manner.

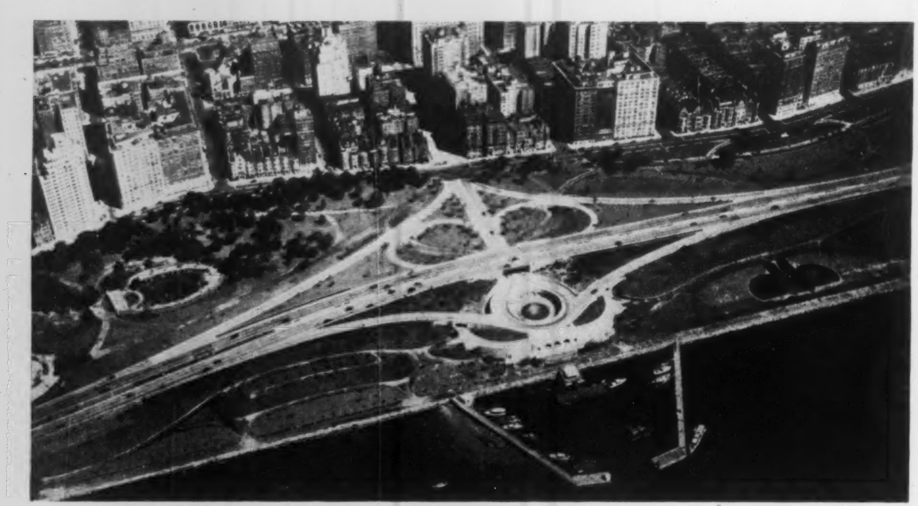
Parkway design changes as does every other mode of our restless modern life. The Bronx River Parkway was designed for the automobile of another generation, and that is one reason why it is admittedly outmoded. While I am no major prophet, I do not think that there is going to be any particular change in automobile design which will render the parkways we are building today obsolete, because I for one believe that a proper speed limit is essential. This limit is 35 miles per hour within New York City, and 40 miles in the suburban areas. However, I am for the motorists' comfort and safety, and the long-radius curves, superelevation of pavements, and long sight distances make for pleasant motoring. Our engineers always try to avoid curves of smaller radius than 1,500 ft. They bank all curves with a radius of less than 10,000 ft, and they use a minimum sight distance of 1,000 ft.

Because of the increased volume of traffic on the parkways, we now place a dividing strip between opposing streams of traffic and make it no less than 6 ft wide, except across bridges. This center mall minimizes headlight glare and provides a safer artery. On the new Belt Parkway, which we hope to make the last word in parkway construction, we are making this dividing strip a minimum of 10 ft wide, except at bridges. To eliminate interference with through traffic movement, every exit and access is planned with decelerating and accelerating lanes of pavement from 350 to 400 ft in length. In this distance, we feel that cars can enter or leave a stream of traffic without causing a slowing up of the flow at each access.

Parking for any reason whatsoever is prohibited. Where possible, 8-ft shoulders are called for to permit disabled cars to drive off the traveled way. Outside curbs are 3 to 4 in. in height, beveled or rounded, to facilitate driving over them. They are capped with concrete made of white cement to increase their visibility. Inside curves are higher to prevent cars from driving on to the dividing strip.

Concrete pavement is colored by adding to the cement 3 per cent by weight of carbon black. Lane widths are 11 ft at the outside of the parkway, 12 ft for the next lane, and in the case of three lanes for traffic going in one direction, 11 ft for the inside. On this type of parkway studies have shown that the middle lane is used for passing, hence its greater width.

The parkways are lighted by twin lights of 400 candlepower, mounted 23 ft from the light source to the pavement and spaced 175 ft on centers. However, complicated clover-leafs should be lighted by general flooding and not conventional parkway luminaires. Parkway lighting is designed to provide only a silhouette of obstacles ahead, and an important part of its value is the path of light it produces. Where more than this mass



INTERSECTION OF 79TH STREET WITH HENRY HUDSON PARKWAY, MANHATTAN, SHOWING BOAT BASIN IN FOREGROUND

outline is needed for safety of access or exit, flood lighting at high mounted height is the solution.

GRADE ELIMINATIONS NOW COMMONPLACE

Parkway grade eliminations, which were marveled at twenty years ago, are now commonplace adjuncts to a properly designed system. There are about 200 of these eliminations in the parkways of the metropolitan area; that they are successful is best proved by their adoption by state highway authorities throughout the country. Full clover-leaves are becoming familiar to motorists, who are also becoming educated to the super-clover-leaves. One of our sophisticated magazines took great delight in showing a picture of a man who had become so thoroughly lost in one of these modern contrivances that rum-laden St. Bernards had to be sent to locate him. However, with proper directional signs, the traffic is taken smoothly through them without left turns or other impediments.

The use of neon lights on these directional signs or similar illumination makes for greater ease at these intersections. The first one designed in the metropolitan area was at the intersection of the Interborough and Grand Central parkways in Queens and will be known to many thousand motorists coming to the World's Fair this year. The triple clover-leaf at the Flushing Bay end of the Fair is going to be just as familiar, as will the traffic "mixing-bowl" at the Triborough Bridge. And now, in the planning stage, is the newest intersection of this type which will carry the Bronx River Parkway Extension over the Bronx-Pelham Parkway very near to a major city traffic artery, the Boston Post Road. The shape of this intersection has grown away from the clover-leaf and is known as the squid type. While these intersections look forbidding on plans, they are designed to eliminate the dangerous left-hand turns and will, with proper directional signs, become as simple for motorists as turning the corner on city streets.

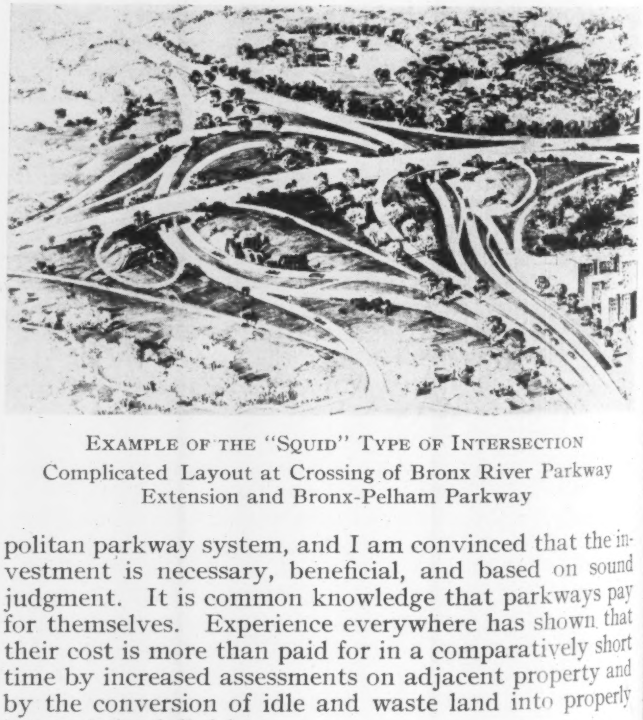
As to the structures required at grade eliminations and the more formidable intersections, a great deal of study has been devoted to their esthetic considerations. Bridges are either stone-faced or their design of concrete and steel is worked out with beauty as the foremost consideration.

While on the subject of the esthetic treatment of parkways, one must not lose sight of the work of the landscape architects who round out the slopes and see that attractive planting is introduced into the scene so that instead of being a traffic artery, pure and simple, the parkway becomes a shoestring park with pleasant vistas and offscapes. Parkway landscaping is not new. Prescott in his *History of Peru*, in describing the civilization of the Incas before the advent of the Spanish, says that the old road-builders seemed to have an esthetic sense, for they built their highways along running streams. Trees and odoriferous shrubs were planted along the margin of the road, according to Prescott, and regaled the traveler with their perfume and sheltered him with their shade.

In the construction of our parkway system, various agencies are involved. Funds for their construction have been obtained by direct appropriation from state, county, or city budgets, by assessment on the adjacent improved property, by bond issue, and by corporate stock issue. Revenue from tolls on bridges is used to pay maintenance charges and pay off bondholders whose money furthered the improvements.

In all instances the municipality or county provides the necessary rights of way, and sometimes carries through the improvement in its entirety. In other cases the state by legislative action provides annual appropriations for parkway improvement. Occasionally federal-aid funds supplement those of the municipality or state. State legislatures must pass the necessary legislation for the setting up of independent authorities and regulate the sale of bonds which are retired from toll or other collections. Legislation is needed for zoning regulations and changes in street systems and the designation of assessment areas.

While a considerable improvement is evident in the comprehensive system of parkway arteries in the metropolitan region, much remains to be done to make it complete and to satisfy present-day demands. To date, approximately $250,000,000 has been spent on the metropolitan parkway system, and I am convinced that the investment is necessary, beneficial, and based on sound judgment. It is common knowledge that parkways pay for themselves. Experience everywhere has shown that their cost is more than paid for in a comparatively short time by increased assessments on adjacent property and by the conversion of idle and waste land into properly integrated subdivisions.



EXAMPLE OF THE "SQUID" TYPE OF INTERSECTION
Complicated Layout at Crossing of Bronx River Parkway Extension and Bronx-Pelham Parkway

Conservation of Water Through Recharge of the Underground Supply

A Paper from the 1938 Water Conservation Conference in Salt Lake City

By A. T. Mitchelson

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"WATER spreading" has long been practiced in southern California as a means of augmenting the underground supply. However, the geological conditions that permit of this type of water conservation are not limited to that area, and in recent years it has been given serious consideration in other parts of the West. As suitable sites for surface reservoirs grow scarcer, it may be expected to come into far more general use. There are four principal methods by which water spreading may be accomplished, as Mr. Mitchelson explains in the accompanying article. He also discusses the general principles involved, and the preliminary conclusions of some current field research in Utah.

THE first recorded case of water spreading as a means of conserving surface flow for storage underground is that of the Denver Union Water Company, which in 1889 spread water over the gravel cone of the South Platte River near the mouth of its canyon. Several years later the practice was started on the cones of San Antonio Creek, Santa Ana River, and Santiago Creek in southern California, where in recent years it has reached a high state of development and is often referred to as the California practice.

Here, because conditions are adapted to this method of water conservation, the practice of water spreading has been extended until now nearly every stream, large and small, entering the valleys from the Sierra Madre Range is equipped with some form of spreading system.

This development was stimulated by notable increases during the last decade in the acreage irrigated by water supplied from pumping plants, and by a rapid increase in the demand for domestic water.

Early water users found the ground-water levels within easy pumping reach; in fact, there were many places where cienegas and artesian flows existed. But the ground-water supply was not unlimited as many thought, and the water levels began to drop as more wells were sunk. Replenishment was retarded by several years of subnormal rainfall, until water was being lifted as much as 300 ft where cienegas once existed. The necessity of storing winter flows for later use became more and more apparent.

Satisfactory surface reservoir sites in southern California are extremely scarce, owing mainly to the steepness of the canyons and the resulting high cost of storage space. Stream flow is very erratic and occurs largely during the winter months when direct diversion for irrigation is unnecessary. It became increasingly evident that the best method to cope with the storage problem was to utilize the natural underground reservoirs as a means of capturing the surface flow. These underground reservoirs or basins are merely valleys filled with recent alluvial material. They vary in size from a few acres to many hundreds of acres of surface area. The Division of Water Resources of the California State Department of Public Works, in Bulletin No. 45, lists 37 rather distinct ground-water basins in the general area known as the South Coastal Basin of California, embracing Los Angeles, Orange, and parts of San Bernardino and Riverside counties. The total surface area where storage takes place is about 840,000 acres, and it is estimated that every foot of rise or fall of the water table represents a change of something like 70,000 acre-ft in the amount of water stored.

These reservoirs are replenished naturally by rain falling directly on the valley floors, by seepage from streams traversing the valleys, and by return water from irrigation. Some of these sources have necessarily been curtailed by the straightening and paving of flood channels and the construction of storm sewers.

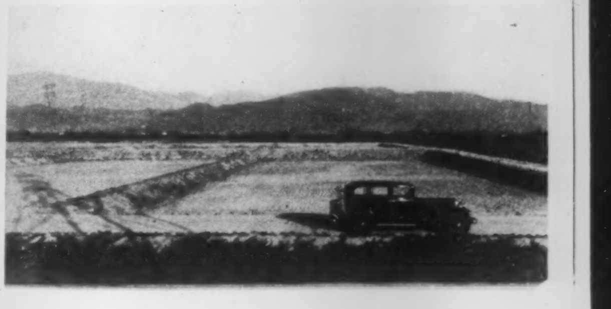
In order to augment the natural methods of replenishment, water spreading was resorted to. Water spreading may be defined as the practice of diverting water from natural channels and spreading it over adjacent porous lands. This may sound like a very simple procedure, but with the conditions encountered on most California streams the problem is exceedingly complicated. First, porous lands must be adjacent to the stream channel and also above the wells to be replenished. These requirements are met on the debris cones at the mouths of canyons, where streams rushing down the steep canyon slopes have dropped their bed loads of sand, gravel, and boulders as they struck the flatter slopes of the valleys. The cones vary in size from a few acres to over 5,000 acres; the surface slopes are in most cases satisfactory, being about 3 per cent.

Control of water on these cones presents a very serious problem, as they are still in the process of formation and in an unstable condition. Each storm brings down varying amounts of silt, sand, gravel, and boulders. This makes diversion of all or part of the flood water difficult owing to the deposition of debris around the headworks and in the diversion canals. On some cones the diversion of flood flows is further complicated by the absence of a well-defined flood channel; and the introduction of a diversion structure of sufficient size to control major floods, by raising the elevation of the stream bed, may tend to throw the stream out of its natural channel.

DESIGN OF SPREADING SYSTEMS

In the design of the spreading system, further problems are encountered. A system is required which will permit the greatest amount of water to percolate to the underground reservoirs in a given time from a given area. Since the surface flow is available for relatively short periods, time is especially important. Area is more a matter of economics because the cost of the spreading system increases with the area developed, and there are many locations where the land available for spreading purposes is limited either by geological conditions or by agricultural development.

It is therefore important that something be known of the conditions favorable to high percolation rates. The Division of Irrigation started active research work on these



Spreading Basins in Tujunga Wash, Operated by City of Los Angeles several factors in the spring of 1930, and results are now available in U. S. Department of Agriculture Technical Bulletin 578, "Spreading Water for Storage Underground."

Spreading is usually done by one of four methods: (1) the basin method, (2) the furrow method, (3) the flooding method, and (4) by the use of pits and shafts. Each has its own advantages and disadvantages and, with the exception of the last named, each is widely used. They are often combined, and it is not uncommon to find all four methods used in a single spreading system. The topography of the soil surface, general slope of the land, amount of land available, condition of water (clear or silty), and stream-flow characteristics are some of the factors that must be considered in the choice of methods.

In the basin method of spreading, the water is impounded in a series of small basins formed by dikes or banks. The basins are so arranged that the entire area may be submerged during spreading operations. The dikes often follow the contour lines and are provided with outflow facilities so that excess water from the basin highest in elevation will escape into the next lower basin. The outflow may occur by overtopping the dike, or by passing through it in pipes. Both methods have proved successful and the choice between them is dependent upon the material available for constructing the dikes.

For the overtopping method, the dike must be of nonerosive material. In southern California the so-called "sausage dam" has been used extensively. It consists of walls of rocks of various sizes bound together with heavy hog wire to form a rock mattress. This form of dam is seldom constructed higher than 8 ft and is not considered economical unless the rock is near at hand so that no hauling is required. Protection should of course be provided at the toe of the dam to prevent erosion resulting from the force of the overflow.

The height of the outflow above the ground surface is usually set so that when the basin is full and water is escaping, the water will have backed up to the toe of the dike forming the lower boundary of the next higher basin, thereby submerging the entire ground surface between the dikes.

This method of spreading is used where the ground surface is irregular and spotted with numerous shallow gullies and ridges. The basins prevent the water from collecting in the gullies and running off before it has a chance to penetrate into the soil. However, spreading by basins is not recommended where the water carries an appreciable amount of silt or foreign material, because it has been found that such substances will seal the surface of the percolating area, and with continued application of such water the usefulness of the basins will be completely destroyed. In the layout of some of the spreading systems, this condition has been overcome somewhat by installing gates at low points of the basins to permit flushing out the deposited silt. A disadvantage of this method of cleaning is that it may be required during a dry period when water cannot be spared for it.

BROAD, SHALLOW SPREADING DITCHES ON LYTLE CREEK, SAN BERNARDINO COUNTY, CALIF.

ARRANGEMENTS AND ADAPTABILITY OF DITCH METHOD

In the furrow or ditch method of spreading, the water is passed through a series of furrows or ditches somewhat resembling an irrigation system. The ditches are shallow and flat-bottomed, spaced close together so as to expose the maximum percolating area. The slopes of the ditches are usually such that the velocity of the water will carry in suspension or as rolling bed load the silt and fine material that is detrimental to percolating areas.

The ditch system usually follows one of three general plans:

1. At right angles to the main diversion canal, lateral spreading ditches are extended parallel to each other at frequent intervals. Pipes or open cuts through the bank of the main feeder canal provide entrance to the laterals. Gates are installed at each entrance so as to control the amount of water entering each furrow. The ditches generally range from 3 to 12 ft in width. Their depth is determined by the roughness of the ground surface, and in general is not greater than that necessary to carry water at a fairly uniform velocity over the ridges and gullies. On the Lytle Creek system, where approximately 500 miles of such ditches have been dug, an average excavation of 9 to 12 in. was necessary.

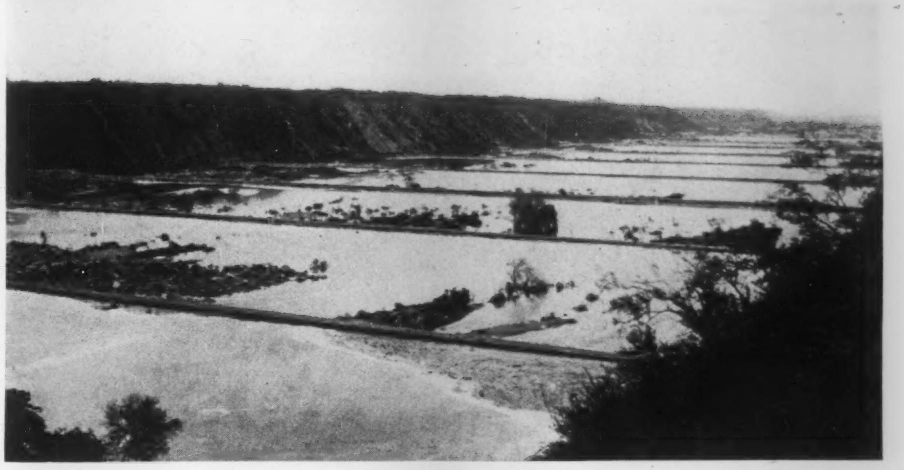
For each series of ditches or furrows in the system, a reception ditch is usually provided. This circles the lower part of the specific spreading area, its purpose being to collect and divert excess water from the spreading furrows into one main canal. It may then be redistributed in a new series of furrows; or if the limits of the spreading area have been reached, the water may be diverted back into the main stream channel. If sufficient water is available, this is recommended as good practice for streams carrying considerable silt, the theory being that the silt will be carried through the spreading system and back into the main stream channel, where periodic floods may move it to the sea.

2. Instead of diverting from the main canal to a series of small ditches, the main canal may be divided into two separate ditches; these two may then be divided into four smaller ditches. Division is continued until the flow in the ditches has dwindled to mere trickles and finally disappears. At each division point, drop gates are provided so as to control the water entering each series of ditches.

3. The third plan is commonly called the contour ditch system. Here the water is spread through one ditch that follows approximately the contour of the ground surface. As the ditch comes to the limits of the area provided for spreading, a sharp switchback is made. Thus, the ditch is made to meander back and forth across the land, gradually approaching the lower part of the spreading area.

No one of these three layouts can be recommended as having any outstanding advantage over another; choice among them is dependent upon the topography and other influencing characteristics of the land.

The ditch or furrow method is used extensively in stream beds, particularly where, because of flood hazard, no permanent works can be installed. Sand bars or islands above the normal flow line of the stream are furrowed by means of horse- or tractor-drawn plows. The water is then diverted into the furrows by temporary dikes or dams.



Cross-Walls Designed to Spread Flood Waters Over the Entire Bed Width of Cucamonga Creek (California) as It Emerges from the Canyon

The ideal method of spreading is to pass the water in a thin sheet, and at low velocity, over the land surface. On areas of gentle slopes, and where the topography is not cut by large gullies and ridges, such flooding produces better results than any of the other methods. Few such areas exist, however, and often certain preparations must be made to prevent the water from collecting in small streams and escaping without spreading over the desired area. Small ditches or embankments may be built to divert the water from the shallow gullies to the higher ridges, where it may spread in all directions, thereby wetting the slopes of the ridges as it again runs to lower levels. By the generous use of these training ditches or embankments, a large part if not all of the area may be wetted.

The highest percolation rates are obtained on areas where the native vegetation and soil covering have been least disturbed. On a properly designed system utilizing the flooding method of spreading, little if any of the percolating area will be disturbed, the native vegetation and soil covering remaining intact.

It is difficult to design a complete flooding system prior to the application of the water. The main ditches, diversion works, and control devices should first be installed; then, with the application of water, the smaller training walls and ditches can be located and constructed to the best advantage. It is advisable to have at least one man on the ground during spreading. The ditches and embankments should be patrolled and inspected, as often such simple adjustments as the placing of a few shovelfuls of dirt in the proper place will divert sufficient water to wet several additional acres. In this manner a well-developed spreading system may be made highly efficient at a very low operating cost.

One method often used to spread water in stream channels should also be classified as flooding. Where the stream has a very wide bottom, caused by the meandering of the channel, a low dam or weir may be extended across the bed. By passing the water over the weir, it is made to spread out in a thin sheet over the entire stream bed and thereby increases the wetted area. Due precaution is of course taken so as not to create a hazard in time of flood by backing up the water or diverting it out of its normal stream bed. There are practically no operating costs in this type of spreading other than those involved in a periodical inspection of the dam or weir.

The fourth method—that of utilizing shafts or pits—does not follow strictly the definition of water spreading, but serves the same purpose of recharging the underground supply. It is not used extensively because of its high cost and other limitations. Shafts or pits are seldom sunk primarily for this purpose; rather, use is made of abandoned gravel pits, wells, or other existing holes.

So much for California practice.

WATER-SPREADING RESEARCH IN UTAH

In 1934 the writer made a study of the practicability of utilizing off-season runoff of streams flowing from the canyons of the Wasatch Range near Salt Lake City by spreading part of the flow over the surface of Bonneville Bench. A favorable recommendation was submitted, conditioned on providing complete control of diversions and distribution. At that time a serious shortage of underground supply in that part of Utah was threatened.

In 1937 an experimental water-spreading project near Centerville, Utah, was started cooperatively by the Forest Service and the Bureau of Agricultural Engineering of the U. S. Department of Agriculture, and the Utah Agricultural Experiment Station. The layout of this experiment consists of a diversion system delivering approximately 3 cu ft per sec of water into a narrow pit or spreading basin about 2,400 ft long excavated in relatively porous material in the side hill just above the town of Centerville. A Parshall measuring flume and a water stage recorder provide a continuous record of flow.

From December 22, 1937, to June 4, 1938, about 350 acre-ft of water was diverted into the basin. Practically all this diverted water has been stored underground, and it is believed that double the amount of water spread during the period cited could be stored during a full year of normal spreading. A. R. Croft, associate conservationist of the Intermountain Forest and Range Experiment Station of the U. S. Forest Service at Ogden, has been in charge of operations, and furnished the data upon which Reed Bailey, director of the experiment station, based the following conclusions:

Observation wells in the town of Centerville, located on the alluvial fan of Centerville Creek, showed higher ground-water levels in 1938 than for 10 to 15 years past, according to well-informed local residents. Wells not located on the Centerville Creek fan show only small, if any, changes in flow and pressure. Although it is too early to make definite representations on the effect of spreading on ground-water levels, it is clear that the stored water is passing through the Bonneville and other deposits on the mountainside into the alluvian and lake sediments of the valley. No wet spots have appeared on the mountainside other than at or near existing springs and seeps.

In the opinion of Messrs. Bailey and Croft, this is the most important trend shown to date, because it strongly suggests that structural relationships are favorable to the recharging of valley ground-water supplies by spreading on the Bonneville sediments. These opinions support the conclusions submitted in 1934 to the officials of Salt Lake City by the Bureau of Agricultural Engineering.

Plans are being made by the Forest Service and the Bureau of Agricultural Engineering, with the informal cooperation of the U. S. Geological Survey, the Utah Agricultural Experiment Station, and the State Engineer, to extend experimental work to other locations in the Salt Lake area, if funds can be made available and local support can be obtained.

Technical Aspects of Refuse Disposal

A Review of Developments in Practice and Research in 1938

THIS review constitutes the fourth annual report of the Sanitary Engineering Division's Committee on Technical Aspects of Refuse Disposal. Previous reports have appeared in the March issue of "Civil Engineering" in 1936, 1937, and 1938. The purpose of this committee is "to stimulate and develop, by studies, reviews, and discussions of refuse collection and disposal problems, a more adequate and impartial engineering basis for this field of sanitation." Its personnel follows: Harrison P. Eddy, Jr. (chairman), Herman G. Baity, Herman P. Cortelyou, Frank E. DeMartini, Walter N. Frickstad, Harry Goodridge, Frank C. Tolles, and Leon G. Williams.

PROBABLY the most outstanding feature of refuse disposal practice in 1938 has been the operation of land fills for the disposal of mixed refuse by the city of New York. Several tracts of low-lying land, varying in size from 12 to 400 acres, were selected in various parts of the city as demonstration areas. Last summer seven of these areas were being worked.

In operating a fill, a dragline excavating machine digs a trench some 30 ft in width and 4 to 6 ft in depth, along a front of about 200 ft. The excavated earth is later used as cover material. Collection vehicles dump their loads on top of the completed parts of the fill, near the trench. A bulldozer then spreads the piled refuse and pushes it into the trench, compacting the fill as it moves back and forth. At the Jamaica Bay site a fill about 12 ft deep was made in this manner. Part of the excavated material is spread to a depth of 9 to 14 in. over the exposed surface of refuse at the end of each day's operations. The final covering of a filled area consists of a layer of earth with a minimum thickness of 2 ft.

It is said that rats are conspicuously absent from these fills. A solution of creosote is sprayed over the working area of the fill and on the access roads several times a day. The spray serves to blanket odors and is effective in combating flies and reducing dust. It was stated last summer that there had been no fires on any of the fills. The chief arguments for the land-fill method are its low cost, which averages about one-fourth of the cost of incineration in New York, and its usefulness in reclaiming marsh land for park areas.

While the land-fill method of disposal is undoubtedly a big improvement over the uncontrolled dumping of mixed refuse, it should be adopted only after consideration of its limitations and the sanitary precautions essential to its successful operation. As a result of the dumping operations on Staten Island, the City of New York is now (February 1939) threatened with litigation for maintaining a nuisance.

With a fill composed of deep layers of refuse, a considerable proportion of which is garbage, decomposition will probably proceed very slowly, settlement may continue for a long period, and subsequent excavation of partially decomposed refuse may be malodorous. On account of prolonged settlement, such a fill cannot be considered as a suitable building site without the use of piles, which of course is true of most fills.

Consideration should be given to seepage from such fills and the provisions which should be made for taking care of it so that it may not become objectionable. In cities where the control of vermin at refuse dumps has not been effective, householders in the vicinity of dumps have suffered severely from the vermin breeding there. Although no fires have been reported on the New York fills, it should be borne in mind that, unless extreme care is exercised in fire-prevention measures, dump fires frequently occur where combustible refuse is present.

Another item that should cause hesitation in adopting the filling method of disposal for garbage and rubbish, as well as ashes, is the scarcity of dumping areas in the built-up sections of almost all cities and the wisdom of husbanding such resources for future need.

Ashes and Rubbish for Land Filling. As is well known, the New York World's Fair is located on what was formerly the "Corona Dump," operated for many years by the Brooklyn Ash Removal Company. Apparently enthusiastic with its experience in reclaiming this area, the city now is cutting down the mountainous dump at Rikers Island and with the material removed is building the great North Beach Aviation Field. Caterpillar trailers used for this purpose have large bodies reported as 40 to 50 cu yd in capacity. The heavily loaded vehicles are said to compact the new fill satisfactorily.

Insect Invasions near Dumps. Dayton, Ohio, has reported trying experiences with invasions of insects into buildings located near rubbish dumps. The insects included gray crickets, water bugs, and sowbugs. When swarming, they are said to be so numerous as to obscure completely the sides of buildings. They are charged with eating the paper off the walls of houses and with devouring whole melons or whole cakes in a night.

The water bugs hide from light in dark corners and sewers, thus adding to the difficulty of their detection and eradication. When the dumps were covered with oil and burned, the crickets are said to have burrowed into the fill, and after the fires were over, to have emerged with vigor. Covering the dump completely to a depth of 6 to 8 in. is reported to have been rather effective in killing the crickets. Perhaps the most difficult of these bugs to destroy was the sowbug, or "roly-poly," which smells like decayed flesh when killed. Covering the dump with uncracked crude oil was more or less effective, but on account of the low flash point, many fires resulted, and dump fires are difficult to put out.

Other treatments which have been tried are sodium fluoride and fluosilicate used with melons for bait, as well as a mash of brown sugar and Paris green. Houses were gassed with potassium cyanide.

Rats and Garbage. The city of Detroit has reported to the Committee that until recently, with no rat-proofing building ordinance applicable to garages and other minor structures, many such buildings have been burrowed under and occupied by rats, as have the concrete slabs in alleys. The food supply for the rats comes largely from defective garbage containers. In 1938, the city spent over $36,000 for rat extermination, which was done by 12 special crews, using exhaust fumes from motors on their light trucks. During the year, the city received 4,115 complaints, serviced 164,600 buildings, and estimated that 10 rats were killed per building at a cost of 2.2 cents each.

Hog Feeding. Since hog feeding is perhaps the most prevalent method of garbage disposal, it is important to note an increasing public consciousness on the subject of trichinosis, especially in California, where publicity on the subject is widespread. No doubt this trend is due in part to studies on trichinosis by the U. S. Public Health Service, the results of which have recently been published. In reporting upon these studies, M. C. Hall describes the rôle of the garbage-fed hog in the production of human trichinosis (*Public Health Reports*, 52:27, 873, July 2, 1937). He states that the available evidence establishes definitely that there is a high incidence of trichina infestation in man in this country. This block of human trichinosis rests on a basis of swine trichinosis. The proportion of garbage-fed swine harboring trichinosis is three to five times as great as that of grain-fed swine, and hence the former group is especially important as a source of human trichinosis. The disease in swine is apparently traceable to the eating of garbage, and particularly uncooked pork scraps, much more often than it is to the eating of rats. Hall concludes that the garbage-feeding industry, as ordinarily carried on, is dangerous to the health of man and livestock, esthetically objectionable, and often economically unsound.

In view of the danger of contracting trichinosis through the eating of garbage-fed pork, some packers now keep pork loins from garbage-fed swine at extremely low temperatures in a freezer for more than 40 days before distributing them to consumers.

Disposal of Garbage with Sewage. Little was reported in 1938 in the way of experimental work with the treatment of ground garbage with sewage or sewage solids, the principal development being the report by Willem Rudolfs and R. S. Ingols that their experiments demonstrated that fresh sludge produced from mixtures of ground garbage and sewage solids can be readily dewatered with the aid of ferric chloride before or after digestion (*Municipal Sanitation*, 9:3, 172, March 1938).

It is reported that at Anderson, Ind., and Findlay, Ohio, the disposal of garbage with sewage sludge by grinding and digestion is comtemplated. At Anderson the digested material is to be incinerated, but at Findlay it is planned to use sludge-drying beds for final disposal.

Some large-scale experiments have been reported from Egypt, where heaps of refuse were sprinkled with sewage or sludge and turned over at intervals of one to four weeks (Carter and El-Din Fahmy, Cairo Government Bulletin 12, November 1937, abstracted by Dr. Rudolfs in *Engineering News-Record*, September 1, 1938). The high temperatures evolved by fermentation are considered sufficient to destroy most of the harmful bacteria. In only one case out of 37 samples was a single hookworm egg found. Dr. Rudolfs' abstract of the original report makes no mention of odor.

Some 6,000 household garbage grinders are now in service in approximately 235 cities in the United States. The increase in the number of such units is so slow as to bear out the Committee's former statements to the effect that, at least for a long time, the number of household grinders will not, on the whole, have much effect on the operation of sewerage systems. It is of interest that, out of 54 cities in excess of 100,000 population which answered a recent questionnaire, 21 stated that discharge of ground garbage into sewers is not permitted.

Salvage. The construction of a new salvage plant in Milwaukee is reported to be under consideration (R. D. Stoelting, *American City*, 53:8, 42, August 1938). Within reasonable hauling distance in Milwaukee, sufficient dumping space remains for only a few years. With an experimental sifting and sorting machine it is said that the city has found it can cut in half its ash load to be dumped; it can salvage enough salable material to pay much of the expense of the salvage plant; and it can recover enough combustible material from the experimental plant alone to heat several city buildings. The refuse has been shown to consist of the following materials, in percentages by weight: fine ash, 48; "combustible ash," 38; tin cans and other iron, 6; glass, 2; paper, 1; and miscellaneous materials, 5. The proposed screening and sifting plant, estimated to cost $52,000, would handle 1,500 cu yd of refuse a day, or about one-third of the city's total production. The tin, iron, glass, and paper would be sold, and the combustible ash would be burned in city buildings. The fine ash would be carried by belt from the hopper to the dumping spot, and the tailings would be burned in a small furnace.

Huge Trailers Compact the Refuse Fill on Rikers Island (New York City)

Salvage of coal from city ashes is not new, even on a large scale. It is practiced on a hand basis on most dumps, and proposals for large-scale separation by flotation have been considered in the past. The public is not interested, however, in buying sifted ashes.

During 1938, use of the rubbish salvage plant at Rochester has been discontinued, as doubtless will be that at Pittsburgh as soon as the proposed incinerator has been completed.

Collection Vehicles. Interest continues in the development of new types of vehicles for refuse collection in which low loading, sanitation, and facility in dumping are emphasized. Cities reporting changes include Pontiac, Mich., Birmingham, Ala., and Montreal.

In Montreal a new unit has been used, comprising an all-enclosed body and equipped with a hydraulic baler, so that all kinds of bulky rubbish and garbage can be compressed into a compact mass (*American City*, 53:12, 111, December 1938). When the load is compressed, water and other liquids are squeezed out. In operation, the loading trough at the rear is filled and the loading doors are then closed and locked. Two compressing jacks then thrust a ram against the refuse in the trough, packing it solidly into the body. In this way a load of 16 cu yd can be compressed into a 10-cu yd body.

New Incinerators. Owing to the PWA appropriations, there was unusual activity during the last few weeks of 1938 in awarding contracts for new incinerators. One of the contracts let during that period was for a 60-ton plant to be built at Burlington, N.C., at an estimated cost of $37,000.

Two of the incinerators at Cincinnati, which have been manually fed and have capacities of 100 tons a day, are being enlarged to 200-ton plants of the crane-fed type. This change from hand to power feed in an existing plant is significant, even if not novel.

An additional mixed-refuse incinerator, with a capacity of 200 tons per day, is now under construction at Minneapolis; and one with a capacity of 225 tons per day is being constructed at Wilmington, Del., to replace two existing smaller plants.

At New Orleans a 60-ton mixed-refuse incinerator was completed and put in operation during 1938. This incinerator is equipped with a suspended, water-cooled, basket grate and a refractory tile preheater. At Cedar Rapids, Iowa, a similarly equipped 150-ton incinerator, with two furnaces, is being built at an estimated cost of $121,500. Similar plants are under construction at Bladensburg, Md. (70-ton capacity), and at Peekskill, N.Y. (90-ton capacity).

THE RIKERS ISLAND REFUSE DUMP SUPPLIES FILL FOR THE NORTH BEACH AIRPORT

At Dayton, Ohio, a plant for burning mixed refuse and drying sewage sludge for fertilizer is being constructed at an estimated cost of $151,000. The incinerator will be of the crane-fed type, with a capacity of 150 tons per day. It will be equipped with a suspended, water-cooled, basket grate and a refractory tile preheater. Part of the hot gases of combustion will pass into a furnace of the multiple-hearth type, where sludge from the sewage-treatment plant will be dried. There is a fairly active demand here for bagged dried sludge for use as fertilizer. The new plant will take the place of a demonstration plant, which has been used for a number of years, in which sewage gas was the fuel used for drying.

At Raritan, N.J., a 24-ton refuse incinerator is connected with a multiple-hearth dryer of 10-ton capacity, the incinerator gases drying the sludge from 75 per cent to 10 per cent moisture.

In Detroit, four new incinerators, with an aggregate capacity of 1,400 tons of mixed refuse daily, have been completed. For many years Detroit garbage had been disposed of by reduction—and of course the public had been urged to keep rubbish out of garbage. As a result, when incineration was adopted it proved difficult to secure all the rubbish produced, and the city was forced to use large amounts of coal for drying the garbage. This is believed to be a temporary condition which can be remedied by the enforcement of a new ordinance. In order to reduce operating costs and to cater to public opinion, two of the incinerators were shut down, and since then some 40,000 tons of garbage have been disposed of by burial. One of the incinerators was reopened in January 1939. Dehydration and shredding of the garbage prior to incineration are being considered.

Several incinerators have been under construction or have undergone improvement during the past year with WPA labor. Such projects at Duluth and Tampa have been completed; others at Atlantic Beach, Fla., Pikeville, Ky., and Hightstown, N.J., are under way; and others at Bridgeport, Conn., Ocala, Fla., Danville, Ill., Baton Rouge, La., East Grand Forks, Minn., Tucumcari, N.Mex., Eastchester and Hicksville, N.Y., and Easton, Pa., have been approved by the Washington authorities.

In the model suburban village of Greendale, Wis., under construction by the Farm Security Administration, water heated in the combustion chamber of a mixed-refuse incinerator, with a capacity of 5 tons per day, will be utilized to heat a sludge-digestion tank. Waste gas from the digestion process will be burned in the incinerator (W. E. Kroening, and F. L. Dieter, CIVIL ENGINEERING, February 1938).

At Rochester, N.Y., the new steam-generating incinerator has been in operation for several months. For the six-month period from July to December, an average steam production of 1.9 lb was obtained for each pound of rubbish received at the plant. This steam is used for reducing garbage in the adjacent reduction plant. The utility company has indicated an interest in buying steam from the incinerator at a pressure of 250 lb when and if the garbage-reduction plant should be abandoned in the future.

At Frederick, Md., a new 60-ton incinerator has been in operation for more than a year, burning garbage and rubbish mixed, before charging, with sewage sludge dewatered on vacuum filters. It is reported that very little if any supplementary fuel has been required.

A similar plant at Winfield, Kans., has been in operation since August 1938. It has been operated 9 hours daily, on the average, burning 6 tons of refuse per day. During the time the incinerator is not operating, about 16,000 cu ft of sludge gas per day is burned in the primary combustion chamber, to keep the system above 400 F.

Shredding Refuse Before Incineration. One of the furnaces in the 215th Street incinerator in New York (abstract of paper by J. C. Zengerle, *American City*, 53:1, 15, January 1938) was altered so that hogged refuse could be partially blown and partially dropped by gravity into the cell. It was found possible to burn about 170 lb of the hogged material per square foot of grate surface per hour—double the designed burning rate.

Reduction Process. Prices of garbage grease, upon which the success of the reduction process depends, were much lower in 1938 than in 1937. About 40 or 50 per cent of the rise in price from the low of 1932 to the high of 1937 was lost in the last quarter of 1937 and during 1938. Prices now are about the lowest since 1934.

The Detroit reduction plant ceased operation in 1938. In Pittsburgh reduction is being continued on a short-term-contract basis, pending the construction of an incinerator. In Schenectady, it is expected that the use of the reduction plant will be discontinued as soon as the incinerator now under construction has been completed.

When these plants have been discontinued, it is believed that the only garbage reduction plants will be those in Boston, Indianapolis, Philadelphia, Reading (Pa.), Rochester, Syracuse, and Washington, and a small one at Royal Oak, Mich.

Manuals. The American Public Works Association has recently brought out its manual on "Street Cleaning Practice," and reports that within a few weeks its manual on "Refuse Collection and Disposal" will be published.

The 1938 Hurricane and Its Effect on Long Island Beach-Protection Structures

By C. L. Hall

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The 120-mile coast line of Long Island lay almost at right angles to the path of the hurricane of September 21, 1938, and bore the full brunt of its attack. Wind and waves and high water took lives by the hundreds and devastated beaches, harbors, and waterfront property. In the present article Colonel Hall gives a brief description of the storm and its effects, and then turns to the lessons that it taught. Chief of these, perhaps, is the lesson that any form of protection—be it bulkhead or sand dunes—must be continuous to be effective. Individual efforts of private owners to preserve their own beach fronts, he says, are not only useless but anti-social.

On the afternoon of September 21, 1938, an unprecedented hurricane swept over Long Island and the New England states. A tropical storm veered from the normal course and struck an unsuspecting populace, leaving more than 500 dead and property damage on the coast line alone estimated at more than $100,000,000. Its effect on beaches, harbors, and waterfront property was particularly devastating.

What man can do to prevent or diminish the destructive effect of such storms on the seacoast and its communities is highly problematical. However, several lessons can be learned from such experiences, which might go far toward this end.

Cyclonic storms known as hurricanes are generated in the South Atlantic doldroms. They are marked by winds of extreme velocity, rotating counterclockwise about a central low-pressure area known as the "eye" of the storm. The eye may vary from 7 to 20 miles in diameter, and the storm itself may have a diameter of between 100 and 300 miles.

Carried with the general drift of the atmosphere, the hurricane moves over the earth's surface at a comparatively slow rate of speed. Although velocities of 150 miles per hour may occur in the vortex itself, the progressive velocity may be as low as 10 miles per hour. The velocities in the vortex to the right of the storm track, being augmented by the forward velocity of the storm, are greater than those on the left side. This right side of the storm, where most of the destruction occurs, is called the dangerous half. The track of a storm is far from uniform. The initial course is to the westward toward the Gulf of Mexico; but, depending on the existence of large normal high-pressure areas in the vicinity, the direction may change to the northward, passing up the Atlantic Coast, or it may continue westward into the Gulf. The normal track is parabolic. Storms passing up the Atlantic Coast usually veer to the northeastward opposite the Carolinas and pass over the Atlantic.

As the vortex, propelled by a flow of free air, moves across the ocean surface, a pronounced tidal effect is caused. The high winds, exerting tractive force on the water, pile up a storm wave. The height of this wave is augmented by a further rise of water caused by the low barometric pressure. Every inch of drop in barometric pressure will permit a rise of approximately one foot in water level. If this rise in level coincides with a normal high tide, even greater heights will be obtained. This rise in water level offshore, however, is negligible compared with the dangerous heights obtained when the wave is propagated against a rapidly shoaling ocean bottom fronting a coast line. Of the extensive damage wrought by a hurricane on a populated coast, the major part is caused by inundation.

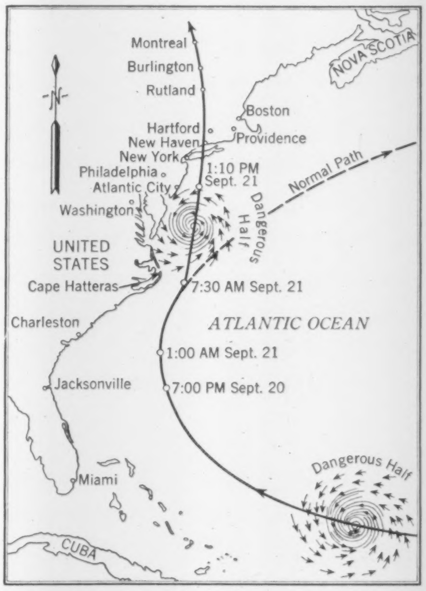


Fig. 1. Path of Hurricane of September 21, 1938

The North Atlantic Coast has had few serious hurricanes. The earliest recorded one in this region was that of August 15, 1635. The frequency of these hurricanes has been about 25 years. Only three are thought to have approached the severity of the recent one.

The path of the 1938 hurricane is shown in Fig. 1. At 10:00 a.m. on September 21 it arrived at the Virginia Capes, and the speed of the eye was 50 miles per hour. At 2:15 p.m., it was east of Sandy Hook, moving 77.7 miles per hour, still north-northeast. About a half hour later the center reached the south Long Island coast between Jones Beach and Saltaire.

The storm then continued north-northeast across Long Island and Long Island Sound and reached the Connecticut coast about 5 miles west of New Haven at about 4:10 p.m. The distance between the south shore of Long Island and the Connecticut coast, about half land and half water, was traversed at a speed of about 35 miles per hour, the storm being slowed down by the trees of Long Island.

As the storm progressed north-northeastward, across Long Island and the Sound, the wind directions at the various stations in close proximity to the storm center of course altered. At New York, some 40 miles west of the storm path, the wind veered 135 deg, swinging from north, to northwest, then to southwest, in a period of five hours. At Block Island, 80 miles east of the storm path, the wind veered 90 deg, swinging from east to southeast, and then to south, in a period of three hours.

As was to be expected, the greatest wind velocities were found in the right, or dangerous, half of the storm. At Watch Hill Coast Guard Station on the Rhode Island coast, immediately north of Montauk Point, a velocity of 121 miles per hour was re-

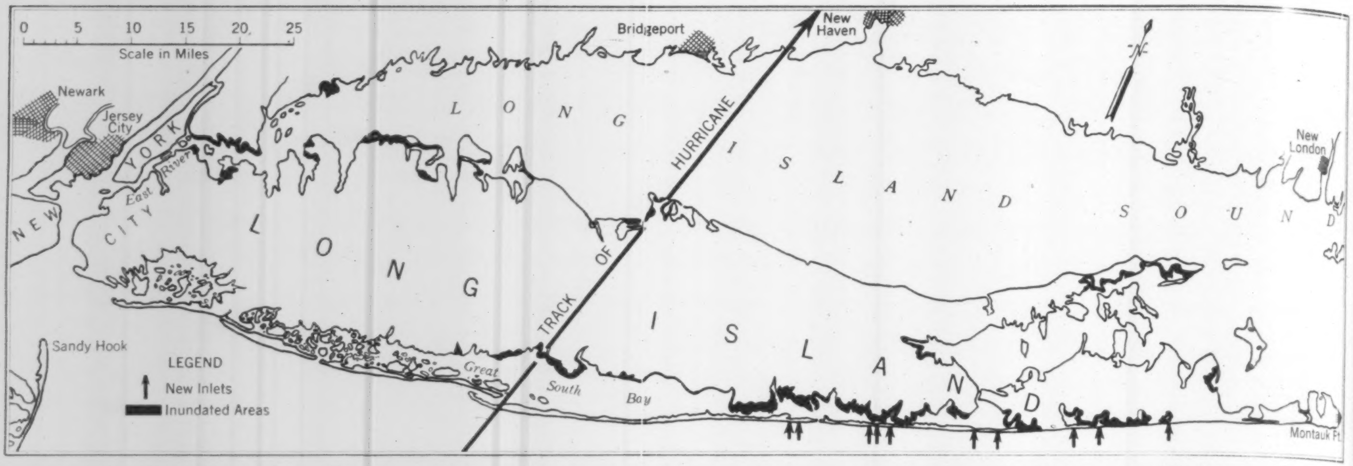


FIG. 2. LONG ISLAND AND VICINITY, SHOWING INUNDATED AREAS ON ISLAND AND NEW INLETS FORMED BY 1938 HURRICANE

ported. At Providence the highest recorded gust velocity was 87 miles per hour, and at the New York Weather Bureau station, 70 miles per hour. Higher velocities were reported in New York at stations of considerable elevation.

In one field near Sag Harbor, Long Island, the wind snapped off nearly all the trees at about 30 ft above the ground. Houses were unroofed, and light summer cottages were overturned. In some regions the general appearance was that of the aftermath of a moving picture hurricane, with scenes manufactured in cardboard, and then magically magnified to life scale. In the nature of things this wind damage fell upon buildings of poor construction, and the net property losses from wind alone cannot have been very large in money, although they were heavy in human tears.

MAJOR DAMAGE FROM WATER, NOT WIND

The abnormally high waters accompanying the hurricane, however, caused damage along the coast line of New Jersey, Long Island, and Westchester, and the New York City metropolitan area, which greatly exceeded that caused by the direct effects of the wind.

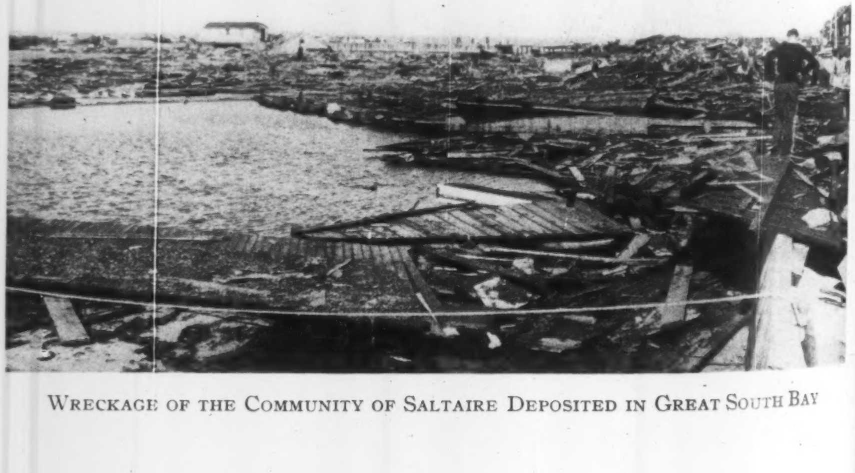
At Montauk Point, which was in the path of the peak of the storm wave, tidal records are unfortunately lacking. However, the storm wave is estimated to have struck the Long Island coast at about 2:30 p.m., preceding the predicted tide by 3 hours and 21 minutes. Its height was about 12 ft above mean sea level, exceeding the predicted high tide by 10.5 ft. If these two tides had been synchronized, the height of the storm wave would have been greater by $1^1/_2$ ft or more.

The gage at Sandy Hook was the only one along the Jersey coast north of Bayhead which operated satisfactorily throughout the storm. From the smudged records of the gages at Shark River Inlet and Manasquan Inlet, however, the storm wave is thought to have struck along that coast at 4:45 p.m. At Sandy Hook the curve shows the high at 3:45 p.m., 1 hour and 53 minutes before the predicted high and 2.6 ft higher than the predicted elevation of +3.3 ft at that point. A secondary crest at Sandy Hook, occurring at 9:30 p.m., was caused by the outflow through New York harbor of part of the flood tide which occurred in the westerly end of Long Island Sound $1^3/_4$ hours earlier. This crest can be traced through four gaging stations in the harbor.

At Willetts Point, where Long Island Sound connects with the East River, the gage maintained by the U. S. Coast and Geodetic Survey was flooded out at 6:45 p.m. Records prior to that time are plotted, and from measurements of high water elevation made on the gage house and an estimated time, the probable curve up to high water has been plotted. It reveals that the crest of the flood tide struck the western end of Long Island Sound at about 7:45 p.m., 1 hour and 51 minutes before the predicted high, and exceeded by 7.3 ft the predicted elevation of +4.7 ft above sea level.

From these data it appears that the storm wave which struck the south shore of Long Island at about 2:30 p.m. was reflected from that shore, part of it striking the Jersey Coast some 2 hours and 15 minutes later. Another and major part of the storm wave impounded against the New England Coast dissipated its head by flowing westward through Long Island Sound in the form of an oscillatory wave, reaching Willetts Point at about 7:45 p.m. As this wave entered the rapidly diminishing cross-section at the westerly end of the Sound, extreme heights were obtained. The recorded 12-ft height at Willetts Point opposite Throgs Neck was greatly exceeded in some of the narrow estuaries along the shore.

The topography of the coast line was an important factor in the disastrous effects of the storm wave. Long Island, extending from New York City in an east-northeast direction to a point south of New London, Conn., presents 120 miles of coast line to the Atlantic Ocean (Fig. 2). Geologically, it consists of two terminal moraines overlying bedrock, clay, and sand of previous ages. One moraine is traceable to Orient Point and the other to Montauk Point. A low outwash plain extends



WRECKAGE OF THE COMMUNITY OF SALTAIRE DEPOSITED IN GREAT SOUTH BAY southward to Great South Bay and Shinnecock Bay. Eighty-five miles of barrier beaches between New York City and Southampton protect the mainland from the sea. Four permanent inlets give access from the ocean to the bays. From Southampton to Montauk Point 35 miles of the mainland are directly exposed to the ocean. Generally higher elevations in this section provide protection against high water.

The barrier beaches of marine origin range in width from 300 to 400 ft to about 4,000 ft, the greater widths being found on Rockaway and Long Beaches to the west, and the lesser on Fire Island beach. The slope of the beaches is generally about 1 on 30 to a point well up on the beach, where sand dunes, at elevations of 10 to 30 ft prior to the storm, provided the necessary barrier to ordinary high waters. At least, nature intended them to provide such a barrier; but human agencies had cut down many dunes, partly for esthetic reasons, partly to provide convenient access to swimming beaches.

EFFECTS OF THE STORM WAVE

Upon subsidence of the storm wave, Fire Island beach was found to have sustained the major effects of the wave. Fifty per cent of the summer establishments on the beach were either destroyed or damaged beyond repair. The wreckage of summer homes at Saltaire, one of the most severely affected communities on the barrier beach, is shown in an accompanying photograph. The wreckage shown was carried 2,000 ft shoreward and deposited in Great South Bay. The protective features of the beach were seriously impaired by the reduction of most of the sand dunes to elevations of 5 to 8 ft. It was found by survey that dunes of 18 ft or more in elevation were generally unaffected, although a slight deposit of sand on top of some of them indicated that they had been overtopped. Between 16 and 18 ft slight erosion was noticeable. Dunes below 16 ft evidently were breached in most cases. In seven localities new inlets were formed.

With the leveling of the barrier beach the bulk of the storm wave gained easy access to the bays, causing a rise of water level in the vicinity of Westhampton and Quoque of about 12 ft.

Here the developments along the low outwash plain of the mainland fell easy prey to the consequent inundation. The approximate areas inundated are indicated in Fig. 2. It is estimated that approximately 7,000 acres of the mainland along the shores of Great South Bay and Shinnecock Bay were affected in this manner. In many cases the slopes of the terrain extending inland from the normal high-water mark were so flat that the water reached one mile inland. Waves were not felt in this area, but the rapid rise in water level caused currents strong enough to shift light summer bungalows from their foundations. It is estimated that approximately 5,000 acres of land on the north and south forks of the island were inundated as the storm wave swept toward the New England shore.

The Jersey coast, which felt the bulk of the reflected storm wave at 4:45 p.m., suffered its major damage at the beach front, where boardwalks, pavilions, and light structures unprotected by bulkheading were demolished, and washed into the dwellings along the marginal street. The populace of this coast, familiar with such depredations of the sea during northeasterly storms, were taken completely by surprise upon seeing the storm wave approach against an offshore or westerly wind.

The extreme high water which occurred at the western extremity of Long Island Sound inundated wharves and shore front on the East River. Some 2,500 acres of land in the vicinity were inundated. Communities at the heads of bays were affected considerably by the higher waters occurring at those points.

All in all the hurricane, both for the natural forces set in play and for its effects on the works of man, was a memorable historical incident.

After the storm is over, the natural question is: What of the future? There are three forms of damage from hurricane—from wind, from waves, and from high water. The methods of protection against these three menaces differ.

Illustrating the Inadequacy of Individual Beach Protection
Serious Erosion Has Occurred in the Background, Beyond the Limits of the Individual Wall

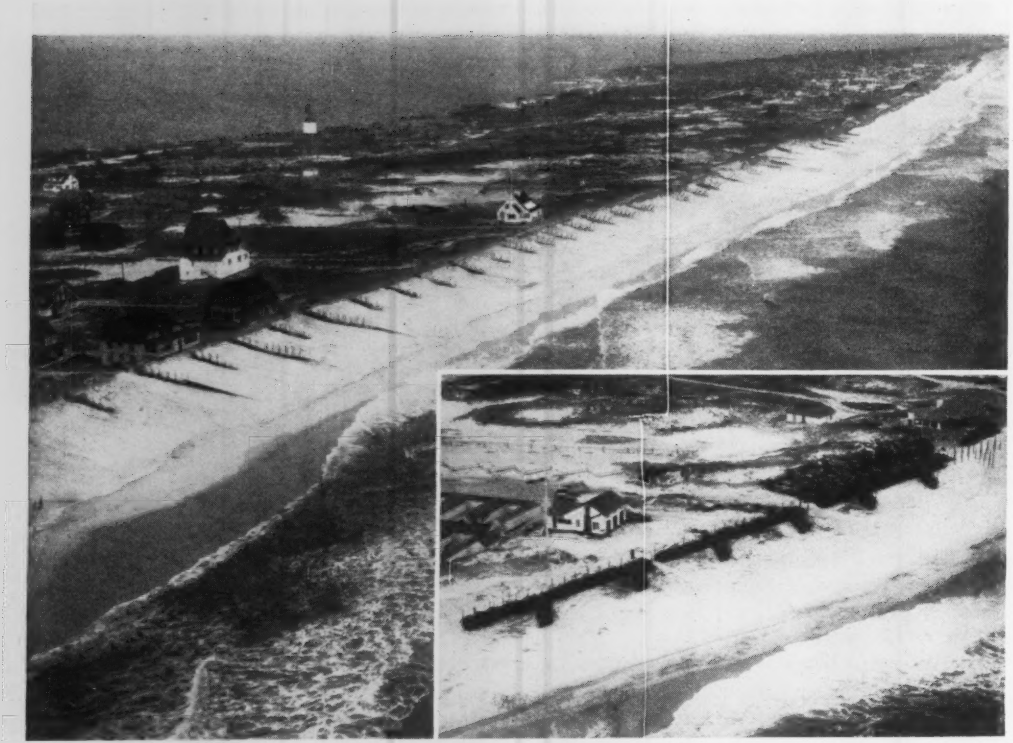
In so far as wind alone is concerned, any structure can be designed to resist any desired wind velocity. Whether such protection is economically worth while is another matter. It obviously is not worth while if it causes the rent of the building to rise to a point where it will always remain vacant. Wind damage from the storm is so variable that it is hard to say just what would have had to be done to protect Fire Island against this particular hurricane if the island had been 50 ft in the air. Something, of course—but perhaps not very much.

The wave and high-water effects cannot always be isolated. The results of erosion and inundation can, however, be conveniently discussed separately.

That the erosive action of the sea is continuous cannot be denied. But its progress is variable, along different shore fronts, dependent upon any number of factors, such as the stage of shore-line development, the resistivity of the material comprising the shore front, and the exposure to waves, rapid currents, and storms. On a wide beach front dunes will form that will act as a natural barrier to the sea. These are of an unstable nature, however, and during periods of severe storms will be seriously eroded, if not washed out completely. If, however, they are left to the action of wind and wave, we can be reasonably sure that they will eventually build up to their former height.

The primary purpose of the sea wall, or bulkhead, is to replace the unstable sand dunes with a permanent structure, which will furnish a line of defense against the erosion of the sea. When there is an insufficient supply of littoral sand, the erosive processes of the sea may eventually erode the beach in front of the sea wall. A sea wall can be maintained under these conditions, but it often proves more economical to design a system of groins, tied into the sea wall, so as to build up and preserve the protective beach in front, rather than to design the sea wall to bear the full brunt of the sea.

Individual efforts of private owners to preserve the beach fronting their properties constitute a costly and



Fairchild Aerial Surveys, Inc.

TWO DIFFERENT ARRANGEMENTS OF BRUSH AND WIRE FENCE BEING USED TO REBUILD SAND DUNES ON FIRE ISLAND

ineffectual attempt to combat the encroachment of the sea, and moreover work an injustice to owners of abutting property. Constant erosion on either side of a protected property finally leaves an isolated promontory which must eventually be abandoned.

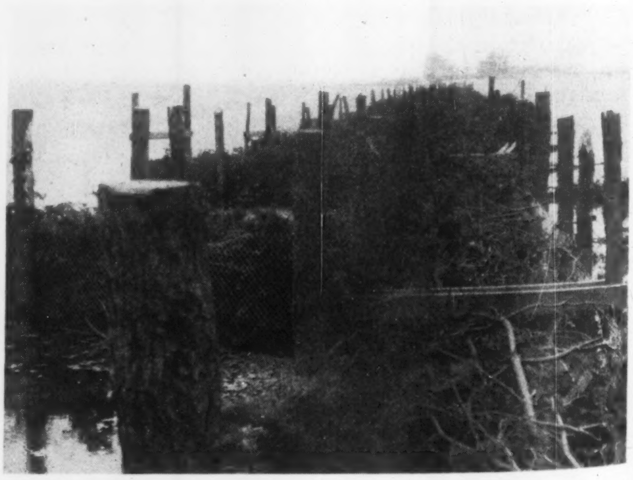
Of the two types of barriers to the sea, natural and artificial, the choice of which shall be resorted to will depend on the economics of the problem. If the valuation of the land at stake does not warrant complete protection, the next best course is to rebuild the dunes. In doing this, we may assist nature by means of sand fences or brush windbreaks. This latter method is now being followed by various communities on Fire Island. At Tiana Beach, brush and wire fences are being placed along the dune line with windbreaks of the same construction extending seaward. At Ocean Beach, brush and wire windbreaks are employed in the form of a system of groins. A close-up of this type of construction is shown in an accompanying photograph. The rebuilding may be hastened by actually piling sand along the dune line to the required elevation. We must admit that protection by dunes, whether built up naturally or artificially, is incomplete. But whether a community adopts the comparatively cheap method of assisting nature, or builds a bulkhead, one thing is certain—an effective protection must be continuous. A non-continuous system is not only useless, it is positively anti-social.

Living on a beach protected only by sand dunes must necessarily be dangerous. The development of such communities should allow for their occasional abandonment. Not until there is full protection by means of miles of uninterrupted bulkhead or sea wall, assisted by groins of adequate design, can people be justified in making any elaborate development of the beach itself.

As to inundation, there is no defense except the utterly impracticable one of raising the area above high water of record; and this is not a complete defense against the future, because high water may go higher still. Something can be accomplished by means of storm warnings to abandon ground, or by preventing the habitation of particularly hazardous areas. In view of the short memory of human beings, one may doubt whether either of these remedies will ever be adopted. People are already reconstructing damaged buildings according to their old plan.

To the engineering profession it is possible, however, to utter a few words of warning that may be heeded. Engineers for riparian property owners will do well to take a leaf from earthquake engineers. The wise ones among them never say a building is "safe." They say it will resist an earthquake with a horizontal acceleration of so-many-tenths *g*, and that, during an accurate record of so many years, this force has never been exceeded at such and such a seismograph, which is so many miles away. We might well adopt the same terminology and agree to protect an area against a hurricane having a maximum wind velocity of so many miles an hour, producing a high water of so many feet above sea level, with waves so many feet high. If, however, we begin to talk about safety as if it were an absolute term, or if—what is almost worse—we argue from the inadequate records of a meteorology of which no one knows too much, and talk about protection against 500-year hurricanes, we will assuredly come a cropper. Kipling described the predicament of the flood engineer of too much assurance in verse:

> In August was the jackal born,
> The rains fell in September,
> Quoth he a dreadful flood like this,
> I really can't remember.



CLOSE-UP SHOWING CONSTRUCTION OF BRUSH AND WIRE FENCE

Weather Bureau's Mountain Snowfall Work

Recent Developments Include an Improved Type of Gage, and Field Research on the Relation Between Snowfall and Runoff

A PAPER FROM THE 1938 WATER CONSERVATION CONFERENCE IN SALT LAKE CITY

By MERRILL BERNARD
MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
CHIEF, RIVER AND FLOOD DIVISION, U. S. WEATHER BUREAU, WASHINGTON, D.C.

ALL the difficulties of obtaining accurate measurements of rainfall are multiplied in the collection of snowfall data. The gages must be designed to function under rigorous conditions found at the high-elevation water-source regions of the West. "Areal significance" is given the record by the use of multiple gage units. After years of experimentation by J. Cecil Alter, official in charge of the U. S. Weather Bureau office at Salt Lake City, a satisfactory gage has been developed, and in 1937–1938 the Weather Bureau had 100 of them in experimental operation in the western mountains, in batteries of five each. At three of these stations special study is being made of snowfall-runoff relationships. In the accompanying article Mr. Bernard tells of this work and its significance.

MEASUREMENT of snow as a form of precipitation has been the responsibility of the U. S. Weather Bureau for many years. Present procedure has developed from a beginning consisting of simple notes and comments on snowfall and cumulative snow depth made by the officers of the Signal Corps in the early days; through the use of the snow stake, the snow table, and the melting and weighing of the catch of an open rain gage; to the recently adopted snowfall station equipped with a battery of shielded storage snow gages.

The successful measurement of snowfall (like the successful collection of all other hydrologic data) must adhere to sound principles of sampling. As a carload of sand must be quartered down to a laboratory sample weighing only a few grams, so must the snow falling over a basin be evaluated by a sample that is equivalent to the residual of a process of careful elimination. The selection of the sampling area should take into account as far as possible all factors known to affect the amount and distribution of snowfall, such as elevation, physiography, and aspect.

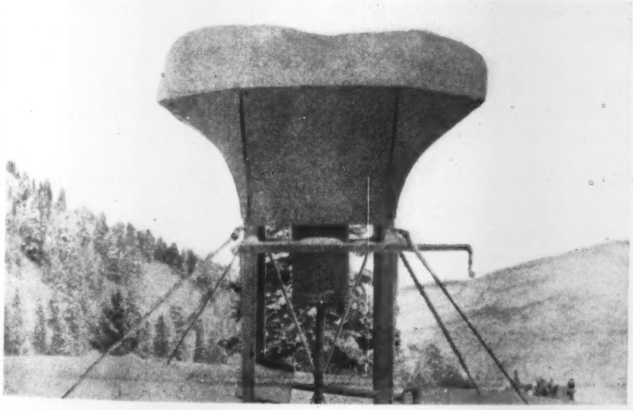


FIG. 1. THE MARVIN GAGE, DEVELOPED ABOUT 30 YEARS AGO FOR COLLECTING SNOWFALL IN WINDY WEATHER

The inherent weakness in the older methods of snowfall measurement, particularly the snow stake—which gives the depth of snow at a point only—lies in the inappropriateness of applying the data areally to that part of the basin the station is expected to represent. Where snowfall is determined by a survey of the snow mantle, this criticism is overcome in that the snow course is expected to give relative value to those factors throughout its length, the composite record of the sampling points along the course being taken as the average for the area represented. In like manner the new snowfall stations of the Weather Bureau will give areal significance to the record by utilizing sampling areas, carefully selected as typical, upon which are placed batteries of storage snow gages, the average of the individual gage records being considered applicable to that part of the basin represented by the snowfall station.

About 30 years ago Prof. C. F. Marvin, of the Weather Bureau, designed a shielded storage snow gage which was theoretically correct for collecting snowfall in windy weather (Fig. 1). It was found, however, that in relatively quiet weather (when much snow falls) the rigid, shelf-like metal shield with which Dr. Marvin's gage was equipped sometimes collected considerable quantities of snow. Some of the snow lodging on the shield later blew into the gage, and the residue, becoming solidified, was found to obstruct the gage receiver.

Experiments with flexible or swinging shields, which would not collect snow, were begun in 1909 by J. Cecil Alter, then an assistant observer in the Weather Bureau office at Salt Lake City. Mr. Alter had previously, in 1907, made a seasonal test of an unshielded storage gage.

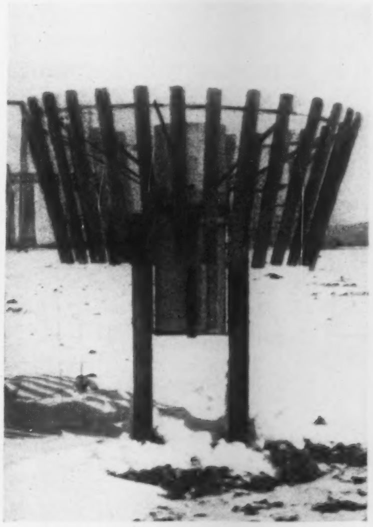


FIG. 2. THE SWINGING SHIELD, WHICH ELIMINATES CERTAIN DISADVANTAGES OF THE MARVIN GAGE

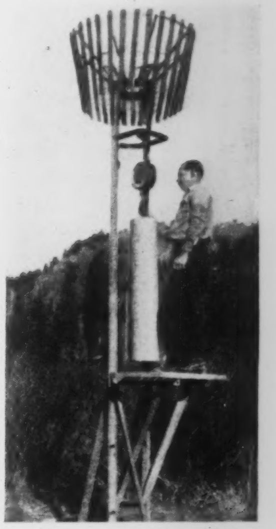


FIG. 3. TYPICAL SHIELDED GAGE—CONTAINER LOWERED FOR WEIGHING

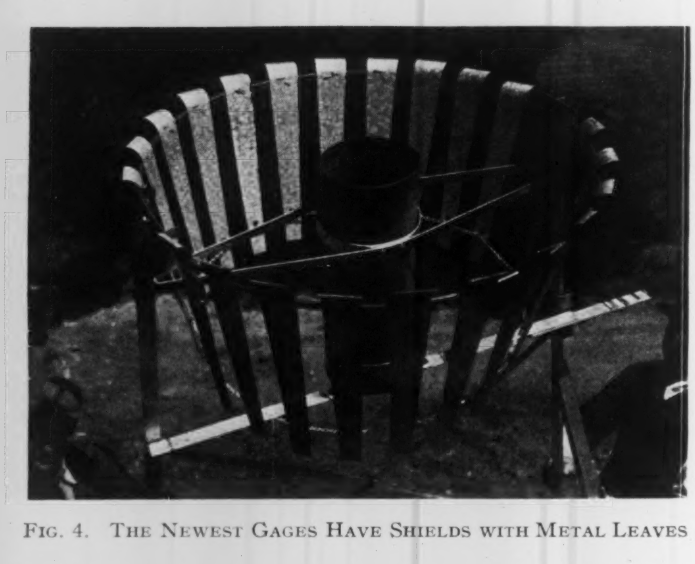


FIG. 4. THE NEWEST GAGES HAVE SHIELDS WITH METAL LEAVES

using an oil film to prevent evaporation, and found that, over a six months' period, the storage accounted for 97 per cent of the sum of the daily measurements recorded in the official gage nearby. As a consequence, several seasonal gages were exposed in Utah during the summer of 1910. In order to carry these storage precipitation measurements through the winter and obtain year-long records, Mr. Alter's tests were continued with anti-freeze solutions and gages with reservoirs buried below the frost line. In the early 1920's, further experiments were made with gages coated on the inside with acid-proof paint, and with the use of common salt to prevent freezing. The method proved so satisfactory that in 1925 a few of the Marvin shielded gages (unattended in winter) were charged with brine and oil, and monthly measurements provided for. These seasonal measurements have been continued to date, giving year-round records where only summer data were previously taken, thus enhancing materially the value of the record.

The most satisfactory type of gage developed from these investigations proved to be the apron-like shield shown in Fig. 2. In effect, the shield functions by closing in upon the container when wind blows against it, thereby reducing appreciably the up-drafts that ordinarily disrupt the snow catch.

Various brines have been investigated. Common salt brine, because of its relatively high eutectic point (−6 F), has been abandoned in favor of calcium chloride, which has a eutectic point of −59.8 F. Loss by evaporation and gain through absorption is prevented by a film of light turbine oil.

During the winter of 1937–1938, there were in operation 20 stations equipped with batteries of 5 storage snow gages each. Thirteen of these were in the Sangre de Cristo Mountains of New Mexico, 4 were in Utah, and 3 in Yellowstone Park. The majority of them are at elevations of more than 7,000 ft above sea level. Figure 3 shows the details of a typical shielded gage and the adopted method of weighing.

The design has been improved materially as a result of the year's experience. In newer gages, the substructure has been strengthened, and metal leaves have replaced the wooden strips in the shield. Other design details have also been improved (Fig. 4).

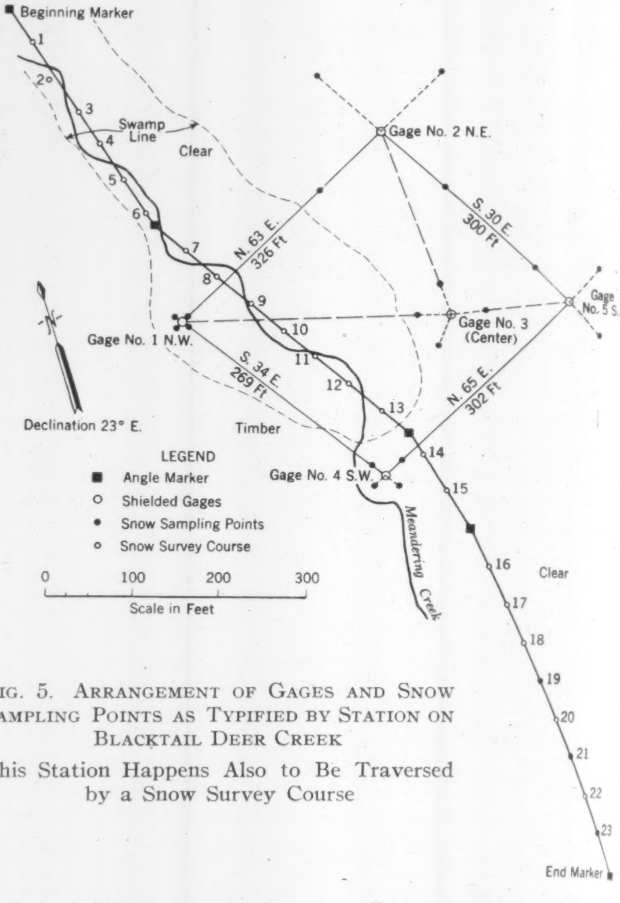


FIG. 5. ARRANGEMENT OF GAGES AND SNOW SAMPLING POINTS AS TYPIFIED BY STATION ON BLACKTAIL DEER CREEK

This Station Happens Also to Be Traversed by a Snow Survey Course

In establishing a station no effort has been made to protect the gages from the sweep of the wind. They are usually placed in an approximate square, with a side dimension of about 300 ft, thus providing a dimensional sample. Figure 5 shows a typical station arrangement.

Operation of a storage snow gage unit is based on the simple expedient of weighing the gages; the increment increase in weight between weighings becomes the snowfall for the period, expressed in inches of water. Nominal container and scale capacities have been adopted, and

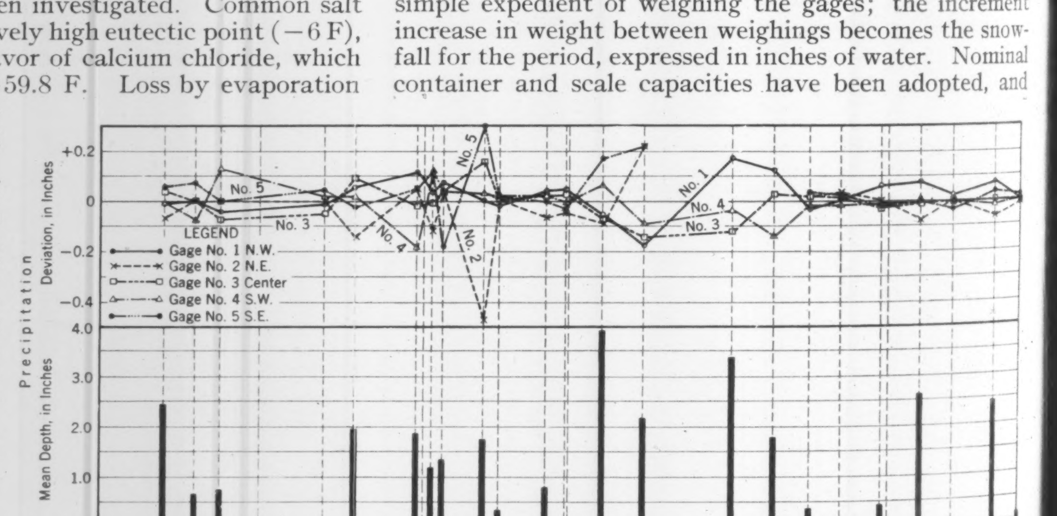


FIG. 6. MEAN CATCH AND DEVIATION OF INDIVIDUAL GAGES FROM MEAN, AT SILVER LAKE STATION, NEAR BRIGHTON, UTAH (1937–1938)

the gages are emptied and recharged when necessary throughout the season. The cumulative weights for each gage are recorded at fairly uniform intervals of from 1 to 30 days from about December 1 to about May 30.

The most interesting aspect of the records produced at the mountain snowfall stations is the consistently small deviation of the catch of the individual gage from the average for the battery. Figure 6 shows snowfall as the increment of water-depth between weighings for the station at Silver Lake, near Brighton, Utah. The differences between the increment-depth of each gage and the mean increment-depth of the group are shown also. An exaggerated depth scale has been used to bring out the relatively small deviations.

Similar analyses of the records of the other 19 stations reveal, with one single exception, the same close adherence of each individual gage record to the mean of the group of which it is a part. The one exception is the gage group on the Blacktail Deer Creek Watershed in Yellowstone Park, whose peculiar deviation pattern is shown in Fig. 7. An explanation of the relatively wide deviations and the symmetrical plots of Gages 2 and 4 must await a further study of the record. Gages 1 and 3 had apparently about the same experience, while conditions at Gage 5 approached those at Gage 2.

Three experimental watersheds, of which Blacktail Deer Creek is one, have been established by the Weather Bureau in Yellowstone Park for the purpose of studying snowfall-runoff relationships. Each watershed has located upon it a battery of storage snow gages and also a snow course conforming in location and operation to the standards of the Bureau of Agricultural Engineers. The sketch shown in Fig. 5 gives the layout for the Blacktail Deer Creek unit, which is typical.

The comparative record of the snow gage units and their respective snow courses is interesting. Figure 8 compares the equivalent water depth as measured by the snow gages with that as measured by the snow courses.

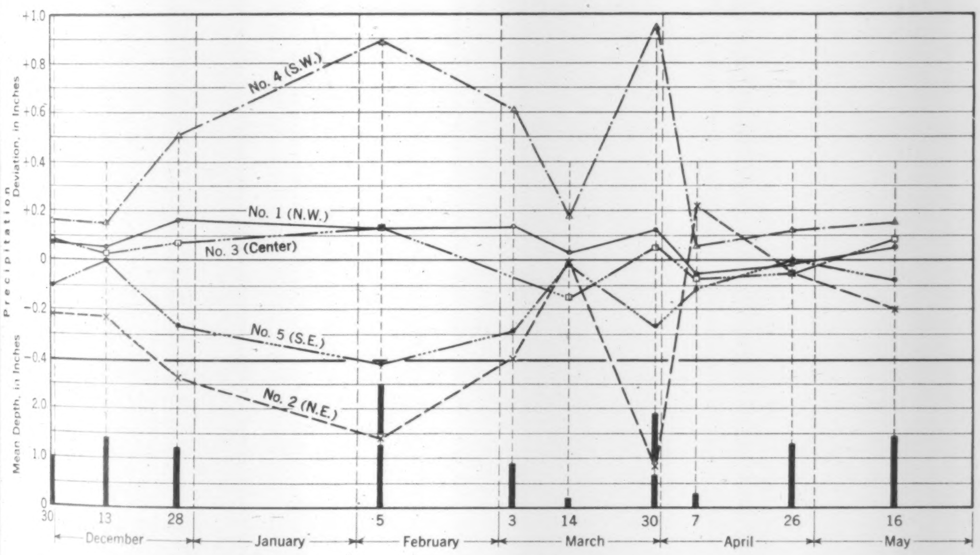


Fig. 7. Mean Catch, and Deviations of Individual Gages from Mean, at Station on Blacktail Deer Creek (1937–1938)

Note the Symmetry of the Deviation Patterns of Gages 2 and 4

The excessive differences on the Blacktail Deer Creek watershed are believed to be due to the poor drainage of the swampy area traversed by the snow course, which undoubtedly has increased the water content of the lower layers of accumulated snow.

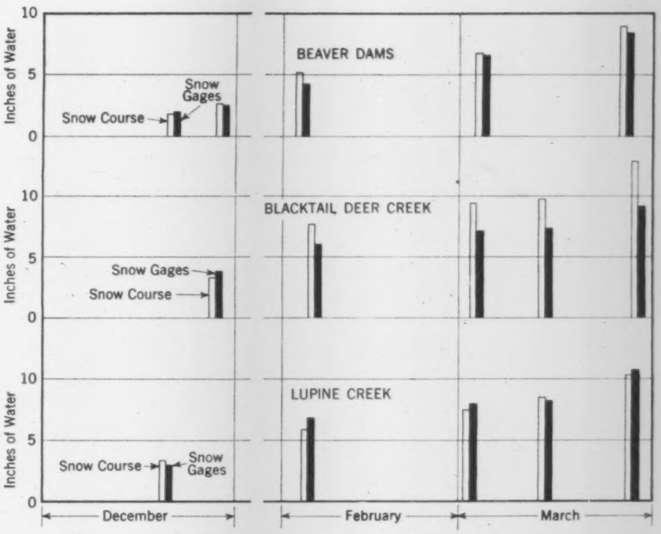


Fig. 8. Comparison of Equivalent Water Depths as Measured by Snow Gages and Snow Courses, at Three Stations in Yellowstone Park (1937–1938)

Stream-flow forecasting for almost all purposes must be expressed ultimately in terms of the hydrograph of flow. In the eastern part of the United States, where heavy snowfall is not involved and where rainfall is the predominating factor, appreciable gains have been made in this direction; by modern methods the forecasts are projected ahead to the time of falling rain, and with some success beyond and into the meteorological causes of flood-producing rainfall. In regions of heavy snowfall a distinct advantage to the forecaster lies, it would seem, in the fact that the mantle, or "snow cloud," obligingly builds up and remains in place until released by rising temperatures and concurrent rains, the source of runoff thereby becoming a constant factor.

There is believed to be a high correlation between the following determinable factors:

1. The amount of snowfall expressed in inches of water over a basin.
2. The chronological sequence of snowfall.
3. A concurrent record of temperature.
4. A factor evaluating ground surface conditions as an index of infiltration losses.

While the many difficulties of forecasting runoff from snow are fully appreciated, it is expected that a number of them will be eliminated when adequate data are made available. Other phases of development must await the results of hydrologic research for more than empirical treatment. Meanwhile, we must be careful not to disparage unfairly the empirical rules and formulas that reflect the judgment and experience of earlier investigators. It is well to keep in mind that our generation, except for taking prompt advantage of the wisdom of its elders, has demonstrated no unusual order of intelligence.

Autobiography of George H. Pegram—Part III

By THE LATE GEORGE H. PEGRAM

PAST-PRESIDENT AND HONORARY MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS

THE current installment of Mr. Pegram's autobiography covers the five years 1893 through 1897, during which time he was chief engineer of the Union Pacific. Mr. Pegram's work during this period included the erection of new steel bridges for the railroad in Wyoming, Idaho, and Kansas. The next installment will include his work with the Interborough Rapid Transit Company.

ON February 1, 1893, I became chief engineer of the Union Pacific System. This was a combination of about 40 railroads with over 9,000 miles of track. It covered a vast expanse of country and was, in fact, the largest railway system in the world.

The main line—from Council Bluffs, Iowa, to Ogden, Utah—was 1,000 miles long. From Granger, Wyo., on the main line, a branch ran to Portland, Ore., and this line was crossed at Pocatello, Idaho, by a north and south line. There were lines from Kansas City to Omaha and to Denver, and from Denver to Fort Worth. The system also comprised about a thousand miles of miscellaneous lines in Colorado as well as small branches in Nebraska, Kansas, and Texas.

The chief engineer's office was in the headquarters building in Omaha. As I first looked out of the window across the Missouri River to Council Bluffs, where I was born, I thought it strange that after permanent residence in so many parts of the United States, I should return at the age of thirty-seven to settle—as I thought and hoped—for the remainder of my life in the place where I was born, as my previous residence had no relation whatever to my return.

After the chief clerk, Mr. Thomas, had introduced me to the office staff, I asked what I was to do first. He replied, "Order a new carpet for the chief engineer's office." I said, "All right! Make out the order." When I asked why my predecessors had not done such an obviously proper thing, he said they probably thought the ragged carpet would indicate an extreme sense of economy. I countermanded the order, explaining "If I am fired next week, I don't want a new carpet for my private office cited as my greatest work on the Union Pacific."

I asked, "What next?" Thomas then laid on my desk a file of correspondence that seemed a foot thick. It covered a disputed claim of the Burlington against the Union Pacific. The property of these two systems adjoined at Omaha, Denver, and other places, and they also used small stretches of track in common, and so disputes arose. I asked what the money value of the claim was, and Thomas replied, "about a hundred dollars." I said, "Make a voucher in favor of the Burlington for the amount of the claim. I would not read that file for a hundred dollars, and think of the cost of the dispute thus far." "But," he argued, "we can't let the Burlington beat us." "Send it to him, nevertheless," I ordered.

And now—see what followed! Shortly afterwards the Burlington submitted a plan defining the boundary between the yards of the two companies, which adjoined in Denver. Previously the undefined course of Cherry Creek had been the boundary. One company would fill in to get more ground, and the other would retaliate by filling in its side. This would so restrict the creek that when a freshet occurred it would cause a wash-out of the tracks—and there would of course be claims for damages. The Burlington's plan to permanently define the course of Cherry Creek seemed sensible, and I had our engineers examine it. They reported that apparently the Burlington had given us the best of the bargain, but as that was unthinkable there must be "a nigger in the wood-pile." I sent for the Burlington engineer and asked him where the "nigger" was. He said, "There is no nigger. We have aimed to favor the Union Pacific in this plan, because after our systems had been bickering for years you came new on the ground and paid us a very doubtful claim." It may be said that the two railroads lived in peace ever after.

RELAXATION FOR THE TIRED RAILROAD MAN

From time to time S. H. H. Clark, president of the Union Pacific, or Edward Dickinson, general manager, would take all the heads of departments on an inspection trip over the main lines. It was very trying to be cooped up for days at a time, so the evenings were religiously given over to play. After dinner the inevitable 25-cent-limit poker game was begun and ran till ten o'clock sharp. It was open to assistants and visitors, and all rank was abolished after dinner. I recall that on one occasion I was deputed to call at Boise City for the governor of Idaho who was to accompany us to Pocatello that night. The governor was also a bishop, and after dinner we had him in a poker game to get his money but, alas, he got ours instead!

While on these diversions of the tired railroad man, I must relate that President Clark once asked me why so much bridge and road inspection had to be done where the fishing was good! I could not answer.

I recall one occasion when we took time off for some shooting on one of our trips. With us was a young man just out of college. He was the finest theoretical sportsman I had ever seen. He appeared for the trip in a corduroy hunting suit complete even to the double-visored cap with the ear lappets tied over the top. We had to advise him which gun to take, light or heavy. He naturally chose to go horseback, although most of us preferred to ride in the buckboards, and when he tried to mount a cow pony on the wrong side we knew we had drawn a prize. Nobody corrected him, and we held the horse until he reached the saddle his own way.

When we retired the Pullman porter confided to our theoretical sportsman that if he saw a chaparral-cock (a kind of pheasant) in the morning, he would wake him before the others. Accordingly he got the young man out at daylight for a beautiful shot. There, perched on a post of the railroad fence, was his bird! The young man blazed away and the feathers flew, but not the bird. Then another shot, with the same result. The others were peeking under the shades of the car windows to see the sport. The bird had been shot the day before, stiffened with sticks, and nailed to the post for the event.

In 1894 it became necessary to replace the wooden bridges of the Oregon Short Line with iron bridges, and I rejoiced at the opportunity to make extensive use of the Pegram truss. There were three 1,000-ft crossings of the Snake River, and one over the Payette River. All these bridges consisted of Howe truss spans on rough masonry piers founded on cribs and surrounded with lava rock for protection. However, the rock so restricted the waterway that the scour was great and the banks endangered. The Payette Bridge was of redwood, which was cracking across the grain to such an extent that chips could be kicked off the top chord. The other bridges, which were of fir, were perfectly sound except that the oak packing blocks between the timbers had completely rotted or "burned" the fir, although the bridges had been standing only eleven years. For superintendent of erection, I secured the services of Edwin F. Terry, who had previously been with us on bridge work for the Missouri Pacific in Louisiana. Terry was powerfully built, handsome, and without much education, but a natural engineer, and the speed with which he erected the Short Line spans was recorded at the time in engineering periodicals. The division superintendent of the road told me he had been a bridge erector and, on one occasion, wanted to go with me to see the work. I told him he had never before seen real bridge erection, and after showing him Terry's work asked him to admit it. He said, "This is not bridge erection. It is ideality."

On one trip with General Manager Dickinson we crossed the Snake at Ontario, where one 200-ft span had been erected. Coming back at sundown, Mr. Dickinson said, "My memory must be going back on me. I remember this as one span and it is two." I explained that he was still sane, the second span having been erected while we were away. Mr. Dickinson was an ideal operating railroad man. He had worked his way up through nearly all the grades and knew his job.

RECOLLECTIONS OF S. H. H. CLARK

I was also rather intimately associated with President Clark, as I accompanied him on his inspection trips over the road. I had previously been associated with him on the Missouri Pacific, when he was their vice-president and general manager, and I was always duly thankful for this close association with a really fine man.

He had a most impressive appearance and manner. He was of spare physique, over six feet tall, but straight as an arrow, with a thick head of hair and long beard of auburn brown reaching nearly to the waist line. He was the best all-around man I have ever known—the best huntsman, the best fisherman, the best poker-player, the best executive, and the best adviser. It was always interesting to see how he would act when complicated situations arose. He had such clear vision that they never seemed complicated to him.

While Mr. Clark was mentally so keen that little explanation was usually required; if he did not want to be bothered with the details or share the responsibility of a matter presented to him, he would display the most exasperating stupidity and ask inane questions until you would fold your tent and quietly steal away. On the other hand, if you were troubled about deciding on the best course to pursue, he would give advice and assume responsibility that should have been wholly yours. He was of such exalted integrity that on the occasion of his taking the stand in the Federal Court, during the Union Pacific receivership proceedings, the judge ordered, "Don't swear, Mr. Clark."

Combined Railroad and Highway Bridge Across the Arkansas River at Fort Smith

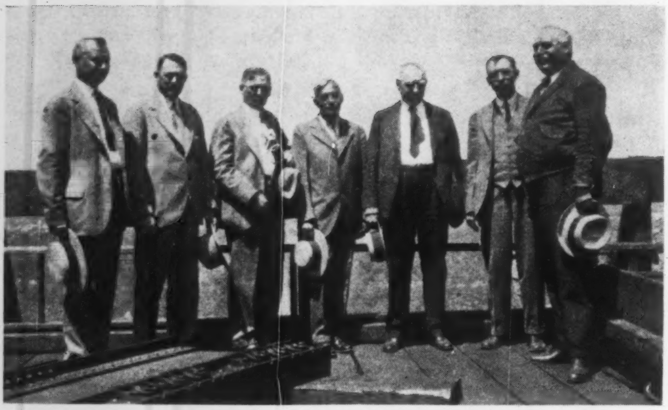
This Was One of the Largest Bridge Structures Incorporating the Pegram Truss

On one of our inspection trips we stopped on a sidetrack near the American Falls of the Snake River in Idaho. I made a cursory examination of the deck bridge across the Snake River, which was located over the rapids just above the falls. The west span of about 200 ft almost abutted the vertical face of the lava rock cliff, which rose 35 ft at the west end of the bridge. While I was on the pier examining the supports of the trusses a freight train passed overhead, and I noticed what appeared to be smoke coming from the face of the cliff. On close examination it proved to be dust coming from cracks on each side of the bridge. A piece of the cliff measuring 30 ft wide by 20 ft thick at the top and tapering almost to a point at the bottom, near the top of the pier, had become completely separated from the cliff as indicated by its crushed base, and its fall on the bridge seemed imminent. Such an accident would have cut our transcontinental line in two for days, or possibly weeks, and there was not the opportunity for detour that exists in most other sections of the country.

When I rejoined Mr. Clark at dinner in the car and related my discovery, he sat pale and quiet for a while. Then he asked the question I had beeen preparing for: "What are you going to do about it?" I replied that I would drill a line of holes in the solid cliff of each side of the fragment, cement I-bolts in the holes, then lace the cliff with wire rope, tightening it against the rock by driven wedges. After that I would take the rock down piecemeal.

When the special was about to pull out after dinner to continue the trip, I remarked, "I guess I'll get off here." To which Mr. Clark replied, "I think you will." It need only be added that the slide was arrested and the rock successfully removed as planned.

In our efforts to avoid a receivership an incident occurred, which contains a lesson. The president asked for an estimate of what I could save by reducing the engineering staff. With much pride I presented a scheme showing that we could save about a third. He said with apparent disgust, "That's nothing. You must do better." To which I replied, "The only alternative I see is to fire everybody." He replied, "Well, fire everybody." I immediately went to my office and wired each of my division engineers, "Discharge your entire force and report to me at Omaha." In a short time complaints came in from the division superintendents. The general manager sent for me and asked what



MR. PEGRAM (THIRD FROM RIGHT) WITH SOME OF HIS ASSISTANTS ON SUBWAY WORK IN NEW YORK

This Photograph Was Taken While Mr. Pegram Was Chief Engineer of the Interborough Rapid Transit Company. This Work Will Be Described in the Next Installment

I was trying to do. I replied, "Carrying out the orders of the president." We went in to see the president, and I told him that I had carried out his orders "to fire everybody." He looked at me a moment and said, "I didn't suppose that any man had the nerve."

But the order was not revoked, and the following is one of the unexpected results. Our line from Salt Lake City to Pioche, Nev., which now forms part of the line to Los Angeles, passed through the Mohave Desert where there is very little rain and, at times, much wind. The embankment of the road was composed of light lava dust and, in spite of all our work, we never seemed to have a good roadbed. After the forces that had been maintaining it had been discharged, and it was left without care, it became a good roadbed. The reason for this is explained by the fact that tamping kept the earth stirred up and the wind blew it away, but when it was left alone the occasional rains, together with the action of the sun, formed a crust that stopped the destructive action of the wind.

MR. PEGRAM INTRODUCES HIS PIPE RIVETER

In 1895 a 6-ft pipe line was constructed in Ogden Canyon for the purpose of carrying water from the Ogden River along the side of the canyon to a point near its mouth at Ogden in order to secure a 300-ft head for the generation of electric power. The pipe was of wood, except the lower end where the pressure required a steel pipe to be used.

I was anxious to introduce a riveter that I had invented to drive rivets simultaneously in the opposite sides of pipes or columns. In a talk with the contractor on this project, he agreed to pay the cost of building a riveter and to give it to me, provided I would design the pipe and direct its riveting with my machine. The pipe was composed of two $^3/_4$-in. plates which lapped on opposite sides.

The riveter consisted of a cast-steel ring, encircling the pipe, and holding-dies, which were screwed up against the heads of the rivets inserted from outside the pipe. The part within the pipe brought pressure on the rivets to form the heads by means of air pressure on a piston connected with toggle joints. I could not risk a failure, so all the $1^1/_8$-in. rivets through the round seams as well as the longitudinal were driven so carefully that none of them leaked or had to be tightened. The average was 525 rivets per eight-hour day, disappointing to me at the time but really a remarkable performance.

My connection with this work led to my being invited to meet the Council of the Mormon Church in Salt Lake City to advise them as to the feasibility and desirability of constructing a dam in Ogden Canyon. C. K. Bannister, chief engineer of the water power project, escorted me to the meeting with President Smith and his council of about twelve gentlemen. They represented the control of the Mormon Church. I never was so impressed. They challenged my admiration for their courtesy, polish, intelligence, and dignity. While none of them was apparently a technical man, they discussed the matter very intelligently. One doesn't often meet such a group, and the explanation probably lies in the manner in which the group is selected. In a community organization like the Mormon Church, the capabilities of all become generally known, and selection is made from a large body by men of recognized leadership.

In the late fall of 1896 Mr. Clark called me to his office and told me that Mr. Jay Gould wished to see me in New York. When I reported to Mr. Gould, he said, "I wish you would look over our elevated railways (which he controlled) and say what must be done to put them in good shape." I accordingly examined them and made a report that demanded some drastic reinforcements. He asked, "How long will these structures last?" I replied that with proper care they should last a hundred years from the time they were built. He then said that he had sent for me because his engineers reported that the structures had about reached the end of their life, and had already prepared plans for the renewal of the Sixth Avenue Line. It was this conference which doubtless led to my being called a little over a year later to be chief engineer of the Manhattan Railway in New York.

In the meantime, I have omitted an important matter. I had always been susceptible to the charms of the fair sex, and that very susceptibility probably operated to keep me a bachelor. It would be hard to desert all for one! In the fall of 1895, however, I had met Miss Jessie Crawford of St. Louis, and on September 8, 1897, I married her at her father's summer residence at Barrie, Ontario.

After a trip through the East, we took up residence in Omaha, where we rented a house. The next month the receivership of the Union Pacific ended, and in the reorganization, the Gould interest retired from control. About this time I submitted my resignation, having accepted the position in New York to which I referred.

Just before I left the Union Pacific, Mr. Dickinson informed me that the U. S. Post Office Department had asked the road to change the name of either Nupher or Nutria on the Oregon Short Line, and they had decided to name either town I might choose after me. I decided on Nupher as I felt that the inhabitants might have less reason to object to the change of Nupher to Pegram. About twenty years later I was attending a banquet in New York when my neighbor at the table, observing my name on the place card, asked, "What relation to you is the town of Pegram, Idaho?" I replied that the town was my namesake, and he explained that he was an architect and had designed the schoolhouse at Pegram.

I left my bride to dispose of the furniture and vacate the house, which we had occupied little more than a month, and arrived in New York on a Monday morning. The next day, February 1, 1898, I reported to Mr. George Gould who, after his father's death, had succeeded to the presidency of the Manhattan Railway, and I was duly installed as consulting engineer.

ENGINEERS' NOTEBOOK

This department, designed to contain ingenious suggestions and practical data from engineers both young and old, should prove helpful in the solution of many troublesome problems. Reprints of the complete department, $8^1/_2$ by 11 in., suitable for binding in loose-leaf style, are available each month at 15 cents a copy.

Actual Duration of "One-Day" and "Two-Day" Rain Storms

By Charles W. Sherman, M. Am. Soc. C.E.

Consulting Engineer, Boston, Mass.

ALMOST allthe records of precipitation have been obtained from gages that were observed once a day. Sometimes the times at which rainfall began and ceased were noted, but usually the record shows only the depth of precipitation in the 24 hours preceding the time of observation. For this reason few rainfall records can be analyzed to show anything more than the rainfall within each day of observation, and flood-producing rains have been studied as "one-day," "two-day," "three-day," etc., storms.

It is obvious that all the rain which fell in a single day of observation may have fallen in a period of an hour or less; that recorded in two days may have fallen in a short period preceding and another short period following the time of observation; and a "three-day storm" may have started shortly before the time of observation on one day and ended soon after the observation was taken on the following day, thus lasting only about 25 hours.

It is probable that everyone who has worked with such records has appreciated this uncertainty as to the actual duration of the storms, yet it is not unusual to see figures of one-day storms used as representing 24 hours of rainfall, two-day storms taken as 48 hours of precipitation, and the like. Perhaps it is assumed that, since only heavy storms are considered, it is unlikely that a really heavy one-day rain could fall in much less than 24 hours; and it must be admitted that such an assumption is logical. Nevertheless, some definite information relating to the actual duration of rains of considerable intensity should be helpful to anyone making use of records of this kind.

For many years, records of rainfall at Chestnut Hill Reservoir (Boston) have been kept and published, including the observed times of beginning and ending. These records for the 25 years 1902–1926 have been studied and classified as they would have been recorded if observations had been taken once each day at 8 a.m.

Since records of light rains could be of no possible significance, only those storms falling within one of the three following classes were considered:

1. Storms in which at least 1 in. of rain fell in one day (8 a.m. to 8 a.m.) and at least 1.5 in. in the entire storm.
2. Storms of at least 2 in. in one day and 3 in. in total precipitation.
3. Storms of at least 3 in. in one day and 4.5 in. in total precipitation. The results of the study are shown in Table I.

Table I. Actual Duration of Rain Storms, in Hours and Minutes

For Explanation of Classifications, See Text

Nominal length of storm:	1-Day	2-Day	3-Day	4-Day	5-Day	6-Day
First Classification						
Number of storms	74	65	36	14	3	1
Average duration	13:00	21:40	45:15	71:35	83:55	112:35
Maximum duration	23:00	40:30	64:15	83:30	90:10	....
Minimum duration	2:55	11:05	26:15	56:05	78:00	....
Second Classification						
Number of storms	6	6	7	6	1	....
Average duration	13:40	25:55	43:30	71:25	83:30	....
Maximum duration	19:45	36:00	53:50	79:15	...	....
Minimum duration	4:30	17:40	31:05	56:05	...	....
Third Classification						
Number of storms	1	1	2	2	1	....
Average duration	13:15	30:40	47:15	73:45	83:30	....
Maximum duration	...	...	53:30	75:30	...	....
Minimum duration	...	...	41:00	72:40	...	....

It is interesting to note that irrespective of the classification adopted, the average lengths of significant storms are nearly the same, that is, for

1-day storms	13 to 14 hours
2-day storms	21 to 31 hours
3-day storms	43 to 47 hours
4-day storms	71 to 74 hours
5-day storms	83 to 84 hours
6-day storms	112 (?) hours

Of course these data may not be applicable in other localities, but it is believed that at least they shed some light on a subject on which only guesses have previously been available.

A Simplified Method for Extracting Cube Roots

By Donald Bregman, Civil Engineer, Los Angeles, Calif.

THE following method furnishes a quick means for extracting the cube root of a number to any desired degree of precision, for any given number whose cube root is greater than 2.

Let the given number be designated by N, and let A be the first approximation to the cube root. We may then write the general cubic equation:

$$(A + x)^3 = N \ldots\ldots\ldots\ldots\ldots\ldots [1]$$

Thus, if the given number be 314,412, the nearest cube to 314,000 (remembering the first nine cubes of 1 to 9, namely: 1, 8, 27, 64, 125, 216, 343, 512, and 729) is $60^3 = 216{,}000$, and Eq. 1 becomes: $(60 + x)^3 = 314{,}412$. By expanding the binomial (in Eq. 1), transposing A^3, and dividing both sides of the equation by $3A$, we get:

$$Ax + x^2 + \frac{x^3}{3A} = \frac{N-A^3}{3A} \ldots\ldots\ldots\ldots [2]$$

In Eq. 2 it will be found, by substituting a number of values for N and A, and solving for x, that beginning with $A = 2$ or >2, and hence $N > 8$, the fractional term $\frac{x^3}{3A}$ may be omitted without any appreciable error in the value of the cube root sought. Hence we may write Eq. 2 in the form:

$$x(A + x) = \frac{N-A^3}{3A} \ldots\ldots\ldots\ldots\ldots [3]$$

It will be noted, in Eq. 3, that the form $x(A + x)$ furnishes a quick means for ascertaining the first figure of x by inspection. Thus, in Example 1 (see below), for $x(4 + x) = 1.67$, the first figure of x was readily ascertained by inspection to be 0.3. Similarly, the value of x in the new equation, $x(4.3 + x) = 0.34$, was ascertained by inspection to be 0.07, thus giving the second decimal figure of the cube root sought. In like manner, the successive figures of this root can be readily ascertained by substituting in Eq. 3 the successive values of A, as done in the examples.

Example 1. Required to find $\sqrt[3]{84}$. The nearest perfect cube to 84 is 64. By Eq. 3 we get $x(4 + x) = \frac{84 - 4^3}{3 \times 4} = 1.67$. Hence, by inspection, $x = 0.3+$, thus giving the first decimal figure of the cube root as 3. To get the next decimal figure, Eq. 3 becomes $x(4.3 + x) = \frac{84 - 4.3^3}{3 \times 4.3} = 0.34$, and by inspection, $x = 0.07+$, thus giving the second decimal figure of the cube root as 7. To get the third decimal figure, Eq. 3 now becomes $x\ (4.37 + x) = \frac{84 - 4.37^3}{3 \times 4.37} = 0.041$, giving, by inspection, $x = 0.009+$. Hence, the cube root of 84 (to three decimal places) is 4.379.

Example 2. Required to find $\sqrt[3]{592,704}$. The nearest perfect cube to 592 is $512 = 8^3$. By Eq. 3, $x(80 + x) = \frac{592,704 - 80^3}{3 \times 80} = 336.27$, and by inspection the first figure of x must be 4. It is noted, of course, that $4(80 + 4) = 336$, and the closeness of 336 to 336.27 suggests that the given number may be a perfect cube—a fact which becomes obvious on beginning the next step.

In conclusion, it may be pointed out that the last figure of a perfect cube provides a ready means of determining, by inspection, the last figure of its cube root, since the cubes of 1 to 9 have none of their end digits alike, the digits being 1, 8, 7, 4, 5, 6, 3, 2, and 9, respectively.

Motion of a Suspended Mass—with Practical Application

By T. H. EVANS, ASSOC. M. AM. SOC. C.E.

ASSISTANT PROFESSOR OF CIVIL ENGINEERING, UNIVERSITY OF VIRGINIA, CHARLOTTESVILLE, VA.

THIS article discusses the motion of a suspended mass whose point of support moves with a constant rectilinear acceleration. Although the writer makes no claim to having solved a problem hitherto unconquered, he has been unable to find the solution in the literature at hand. The peculiar motion of such a system was first suspected while watching the oscillations of concrete buckets running out on the long cableway at the Conchas Dam project in New Mexico.

In the system shown in Fig. 1, the mass, m, is assumed concentrated at B, a distance l from the point of support, and the support is subjected to a constant rectilinear acceleration, a. Damping effects are assumed to be negligible. In other words, the system is that of a simple pendulum with a moving support.

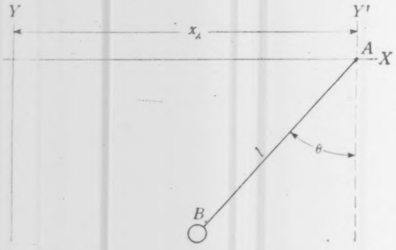


FIG. 1

In order to determine the motion, generalized coordinates and the Lagrangian equation of motion will be used. In this case we need two coordinates to care for the two degrees of freedom: x_A for the position of the point of support, and θ for the inclination of the supporting member from the vertical.

The Lagrangian equation of motion is:

$$\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q}}\right) - \frac{\partial L}{\partial q} = 0 \ldots\ldots\ldots\ldots [1]$$

where $L = T - V$, and T and V are the kinetic and potential energy of the mass; and q is any coordinate. In the equations, $(\dot{\ })$ and $(\ddot{\ })$ indicate, respectively, the first and second derivatives with respect to time of the variable over which they appear.

From the figure, $x_B = x_A - l \sin\theta$; $\dot{x}_B = \dot{x}_A - l\dot{\theta}\cos\theta$;

$\ddot{x}_B = \ddot{x}_A - l\ddot{\theta}\cos\theta + l\theta^2 \sin\theta$. Also, $y_B = -l\cos\theta$;

$\dot{y}_B = l\dot{\theta}\sin\theta$; $\ddot{y}_B = l\ddot{\theta}\sin\theta + l\dot{\theta}^2\cos\theta$.

Then $T = \frac{m}{2}(\dot{x}_B^2 + \dot{y}_B^2) = \frac{m}{2}(\dot{x}_A^2 - 2\dot{x}_A l\dot{\theta}\cos\theta + l^2\dot{\theta}^2)$

and $V = -lmg\cos\theta$, whence $L = T - V =$

$$\frac{m}{2}\left[\dot{x}_A^2 - \cos\theta\,(2\dot{x}_A\, l\dot{\theta} - 2lg) + l^2\dot{\theta}^2\right]$$

$$\frac{\partial L}{\partial \dot{\theta}} = \frac{m}{2} - 2\dot{x}_A l\cos\theta + 2l^2\dot{\theta}).$$

$$\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{\theta}}\right) = \frac{m}{2}(-2\ddot{x}_A l\cos\theta + 2\dot{x}_A l\dot{\theta}\sin\theta + 2l^2\ddot{\theta}).$$

$$\frac{\partial L}{\partial \theta} = \frac{m}{2}(2\dot{x}_A l\dot{\theta}\sin\theta - 2lg\sin\theta).$$

$$\text{Therefore } \frac{m}{2}(2l^2\ddot{\theta} - 2\ddot{x}_A l\cos\theta + 2\dot{x}_A l\dot{\theta}\sin\theta - 2\dot{x}_A l\dot{\theta}\sin\theta + 2lg\sin\theta) = 0$$

from which $l\ddot{\theta} - \ddot{x}_A\cos\theta + g\sin\theta = 0$

and
$$\ddot{\theta} + \frac{g}{l}\sin\theta - \frac{a}{l}\cos\theta = 0 \ldots\ldots\ldots\ldots [2]$$

If we now let $\dfrac{g}{\sqrt{g^2 + a^2}} = \cos\omega$ and $\dfrac{a}{\sqrt{g^2 + a^2}} = \sin\omega$,

then $$\ddot{\theta} + \frac{\sqrt{g^2 + a^2}}{l}\sin(\theta - \omega) = 0 \quad\ldots\ldots\ldots [3]$$

which shows a periodic motion about some inclined axis.

Now let $A = \dfrac{\sqrt{g^2 + a^2}}{l}$ and multiply through by $\dot{\theta}$.

Then $\ddot{\theta}\theta + A\dot{\theta}\sin(\theta - \omega) = 0$, and integrating, $\dfrac{\dot{\theta}^2}{2} - A\cos(\theta - \omega) + C_1 = 0$. Since the system was assumed to be vertical when the time was zero, $\dot{\theta} = 0$, when $\theta = 0$, and $C_1 = A\cos(-\omega) = +A\cos\omega$. Therefore,

$$\dot{\theta}^2 - 2A\cos(\theta - \omega) + 2A\cos\omega = 0 \quad\ldots . [4]$$

A similar relationship would still be obtained if $\dot{\theta} \neq 0$ when $\theta = 0$. In other words, there might be an initial velocity when $t = 0$.

$\dot{\theta}$ also equals zero when θ attains some maximum value, θ_0, since there is periodic motion. Thus $0 = -2A\cos\omega + 2A\cos(\theta_0 - \omega)$, or $\cos(\theta_0 - \omega) = \cos\omega$,

whence $$\omega = \frac{\theta_0}{2} \quad\ldots\ldots\ldots\ldots\ldots\ldots [5]$$

Now $$\tan\omega = \frac{\sin\omega}{\cos\omega} = \frac{a}{\sqrt{g^2 + a^2}} \times \frac{\sqrt{g^2 + a^2}}{g} = \frac{a}{g}$$

Therefore $$\frac{\theta_0}{2} = \tan^{-1}\frac{a}{g} \quad\ldots\ldots\ldots\ldots\ldots\ldots [6]$$

This is the angle at which the pendulum would finally come to rest if there were damping in the system. It is ω, the angle of inclination from the vertical of the axis of symmetry of the oscillations.

The analogy to the simple pendulum was of course apparent from Eq. 3, which implies an inclined axis of vibration that travels with the support. It is even more striking, however, when we note that it oscillates as though acting under the influence of an inclined gravity field of magnitude $\sqrt{a^2 + g^2}$. This is apparent when one recalls the differential equation of the motion of a simple pendulum without damping to be $\ddot{\theta} + \dfrac{g}{l}\sin\theta = 0$.

To bring out the analogy even further, if $\theta = \theta_0/2$, and $\dot{\theta} = 0$ when $t = 0$, then there will be no vibration at all about ω as the support moves. The analogy comes from the fact that a simple pendulum held vertically will not oscillate when released.

All of the motion just described is of course relative to a moving vertical axis. The Lagrangian equation was used in the solution of this problem to demonstrate its utility. In some cases the form leads to a simpler solution than would other methods. In this case, however, the problem could have been readily solved by the use of the more common Newtonian equations, or by Corioli's law.

The relationships discussed here are of practical value in determining the maximum pull to which the body may be subjected while in motion. They also show how the oscillations of large suspended masses of this type can be stopped by "jockeying" the carriage.

It might be of interest to see how the total tension in the supporting member varies for several different values of θ by assuming a hypothetical case. Consider a concrete bucket supported by hoist cables from a trolley running on the main track cable. Load and bucket weigh 6 tons and are 75 ft below the carriage. The track cable is assumed to be horizontal and of indefinite extent. Acceleration of the trolley is maintained constant at 9.66 ft per sec per sec. A free body diagram of the bucket, which started directly under the carriage, is shown in Fig. 2.

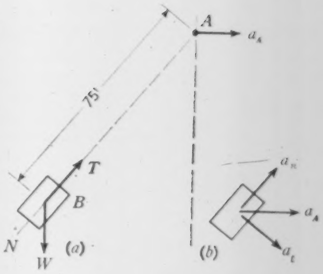


FIG. 2

In order to find the value of the tension, T, it is only necessary to resolve all forces parallel to the N axis and use the Newtonian equation $\Sigma F = Ma$, in which a equals $a_n + a_A \sin\theta$.

$a_n = l\dot{\theta}^2$ and a_A is 9.66 ft per sec^2. Thus $-W\cos\theta + T = W/g(l\dot{\theta}^2 + a\sin\theta)$

and $T = W\left(\cos\theta + \dfrac{l\dot{\theta}^2}{g} + \dfrac{a\sin\theta}{g}\right)$ when $\theta = 0$ or θ_0, $\dot{\theta}^2 = 0$, from Eq. 4. Hence

$$T_{\theta=\theta} = W\left[\cos\theta_0 + \left(\frac{\sin\frac{\theta_0}{2}\sin\theta_0}{\cos\frac{\theta_0}{2}}\right)\right] = W = 12{,}000 \text{ lb.}$$

When $\theta = \dfrac{\theta_0}{2}$, $\dot{\theta}^2 = \dfrac{2\sqrt{g^2 + a^2}}{l}\left(\cos 0 - \cos\dfrac{\theta_0}{2}\right)$

Therefore

$$T = W\left[\cos\frac{\theta_0}{2} + \frac{2\sqrt{g^2 + a^2}}{g}\left(1 - \cos\frac{\theta_0}{2}\right) + \frac{a}{g}\sin\frac{\theta_0}{2}\right] =$$

$$W\left(\frac{3 - 2\cos\frac{\theta_0}{2}}{\cos\frac{\theta_0}{2}}\right) = \frac{1.084\ W}{0.958} = 13{,}580 \text{ lb.}$$

If the bucket had started at an angle $\theta_0/2$ back of the carriage, it would have remained there during the travel and the only acceleration imposed on it would be that of the trolley, a. In that case,

$$T = \frac{W}{\cos\frac{\theta_0}{2}} = \frac{W}{0.958} = 12{,}530 \text{ lb}$$

Thus, in this ideal case the tension has its highest value as the load swings through the position $\theta_0/2$. Now if the track and motion were indefinitely long, damping would soon cause the bucket to remain at $\theta_0/2$. In a practical case of this sort, however, damping does not have much chance to affect the motion since the load ordinarily reaches its stopping position in a relatively short time. Further, the track cable is never actually horizontal, and this causes the trolley to start "down grade." However, since the direction can be found, the problem of determining the acceleration of the load can still be solved.

As actually operated, the trolley does not suffer a constant acceleration. Rather, the acceleration varies constantly owing to braking of the car. If swinging of the load is undesirable, it can be stopped by a skillful operator, who will brake or "jockey" his car at just the right time. Thus by superposing an acceleration of the opposite sense on the bucket, he can cancel or reduce the motion at will.

OUR READERS SAY—

In Comment on Papers, Society Affairs, and Related Professional Interests

Economic Factors of Hydro Plant Design

To the Editor: In his article in the January issue, H. G. Gerdes presents a large amount of cost data on hydroelectric power plants. Most of the data are illustrated graphically by curves showing an average cost of individual elements of a plant expressed in dollars per kilowatt against feet of head. Apparently engineers are by no means unanimous about the utility or even justification of such an attempt to compare and correlate costs of power developments and their component parts because they feel that each hydroelectric plant is a problem in itself and so much dependent on local conditions that generalized comparisons are out of place.

It might be well to point out that among the component parts of a hydro plant, there are evidently some which can be compared more readily than others. The substructures, for instance, have become fairly well standardized in their general outline during the past 15 or 20 years, and comparison of quantities with reference to a common standard, such as concrete volume per kilowatt, is obviously instructive. But when dollars per kilowatt are compared reservations should be made because cost may be affected to such an extent by location, changes in the price level, and other factors, that wrong conclusions are possible.

The distinction made by Mr. Gerdes between cost efficiency of design and cost efficiency of construction is much to the point. There is an economical balance between the two which possibly has not always been clearly recognized—that is, refinements of design may sometimes have been applied to a point where the resulting complications in construction nullified the expected savings in volume. It must be remembered, however, that under certain conditions increased capital costs for certain items may be advisable to insure greater dependability of service or lower cost of operation and maintenance. For instance, in a northern climate provisions against ice always require some expenditure not necessary in more favorable latitudes.

From Mr. Gerdes' figures it appears that in the volumes for power house substructure and superstructure parts not directly attributable to each generating unit have been prorated and included. There can, of course, be considerable variation in such requirements in different developments. Elimination of this source of irregularity by separating volumes and structures required for main generating units only from those required in addition for auxiliary service would afford a more useful comparison.

It may also be questioned whether the influence of the electrical layout on space and cost of power plants has been given sufficient recognition in the paper and whether it is proper to leave high-tension features entirely out of the picture. Installation of high- as well as of low-tension equipment generally has a considerable bearing upon design and cost of power house superstructure and may also affect the substructure. Generally speaking, a simple and inexpensive layout of low-tension features may call for an elaborate layout of high-tension features and vice versa so that it is misleading to include only the low-tension equipment in the comparisons of plant costs.

In comparisons of turbine costs, it would be desirable to cite in each instance what type of turbine was used. Kaplan turbines, for instance, are considerably more expensive for equal capacity than Francis wheels, although for a given case their operating characteristics may make them economically superior. On the other hand, they are likely to produce a higher degree of what Mr. Gerdes calls "relative space efficiency."

These comments are offered to stress the fact that while such comparisons as those shown are thought-provoking and valuable in producing a picture of the relative costs of different items in a hydro plant, there are strict limitations to their usefulness.

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Water and Power Company

Baltimore, Md.

Dear Sir: I have read with a great deal of interest the article, in the January issue, entitled "Hydro Power Plant Space and Cost Trends," by H. G. Gerdes.

From reading the article I fail to see any merit in the conclusions drawn by Mr. Gerdes, and it seems to me to be an entirely erroneous assumption that kilowatt capacity of a hydroelectric plant is a measure of design and construction efficiency.

Aside from certain general principles of design, the development of any plant must be predicated on conditions existent at the particular location, and the overall estimate of cost must determine for the particular system or purpose for which the plant is proposed whether the cost will justify its installation. Comparison of unit costs as between different plants may or may not mean anything, but certainly comparison of quantities means nothing because natural conditions are never alike and hardly ever even similar. This seems to be conclusively shown by the diagrams presented by Mr. Gerdes.

I am quite surprised that what I assume to be an editorial comment apparently endorses the article and attaches to it an importance that, in my opinion, it does not deserve.

W. N. Patten, M. Am. Soc. C.E.

Boston, Mass.

To the Editor: In his article on "Hydro Power Plant Space and Cost Trends," in the January issue, Mr. Gerdes presents a diagram (Fig. 1) plotting the cost per kilowatt of power house and equipment against head in feet for a group of nineteen plants—ten built in the period 1929–1938, eight between 1919 and 1928, and one between 1909 and 1918 (used only for minor purposes). Above 180-ft head there are only two plants. Mr. Gerdes has not included engineering and overhead costs and has adjusted costs, where later units are contemplated, to the ultimate cost and capacity. No adjustment of plotted points for cost variations has been made, although in the whole period considered the cost index varied 50 per cent or more.

Mr. Gerdes' plot shows variations for individual plants of about 20 per cent from his mean curve, for which he has developed equations as follows:

$$\text{Below 100-ft head, cost} = \frac{227}{\sqrt[3]{H}} \text{ (including intake)}$$

$$\text{Above 100-ft head, cost} = \frac{184}{\sqrt[3]{H}} \text{ (excluding intake)}$$

Similar plots which the writer has recently constructed, based upon cost data of some 70 plants with heads up to about 2,600 ft, give a materially different form of mean curve from that given by Mr. Gerdes. Moreover, individual plants show variations from this mean curve of 50 to 70 per cent even after adjustment for cost index.

It is obvious that any such mean curve or equation, while of general interest, is of no value in estimating costs of power house and equipment for a specific site.

There are many other site and load factors, in addition to head, which affect the cost per kilowatt of power house and equipment. These include size of river, velocity conditions, and so forth, which affect the handling of water during construction; foundation conditions; location, with particular reference to cost of materials; prevailing costs at the time as shown approximately by the cost index; and extent of development—a peak-load plant will be developed to the flow available 5 per cent or less of the time, while the usual 24-hour load plant can be developed only to 25 or 30 per cent of the time flow. All these factors affect the cost per kilowatt of power house and equipment, resulting in large departures in cost for individual plants from any mean curve, such as Mr. Gerdes suggests, which fails to allow for the variation in these site factors.

In the last analysis the important thing is the cost per kilowatt-hour of the hydro power, taking into account the entire plant from dam to tailrace. Power house and equipment costs usually represents not over one-third the total cost of plant, and their relative economy is only a part of the complete picture.

Certain of the types of curves proposed by Mr. Gerdes, such as costs of turbines and generators and volumes and costs of power house superstructure, may be useful for estimating purposes—with due allowance for cost changes—but should be more closely developed with additional data. Moreover, the range in cost should be noted, as well as results taken from a mean curve.

While Mr. Gerdes has made an interesting study of the cost of one of the parts of a hydro plant, it cannot properly be used as a basis for the determination of the comparative economy of hydro plants—or even of power house and equipment costs alone. This can only be done accurately by a critical study of each plant by itself by experienced engineers with a knowledge of all the conditions that had to be met in design and construction.

H. K. Barrows, M. Am. Soc. C.E.
Consulting Engineer

Boston, Mass.

To the Editor: Mr. Gerdes has submitted an interesting study, but his statements seem to indicate a belief that the fundamental factors governing the economics of power plant design have been too little considered, and that the proportions of power plants have been selected without full weighing of the cost factors involved. I do not think that this is true, although I realize that it is very easy to misinterpret cost figures and to draw incorrect conclusions from them, particularly if comparisons of cost fail to take into consideration some of the more important variable factors affecting such costs. Moreover, the kilowatt has been selected as the proper yardstick for the various comparisons made. This unit is often used as a measure of the cost of a complete power project, or major electrical items, but when used indiscriminately it may produce—and I believe in the case of Mr. Gerdes' paper has produced—conflicting and confusing results.

Comparisons of cost to serve any useful purpose must be placed on a truly comparable basis. Labor and material prices vary from year to year, and also for different parts of the country. The particular plants compared by Mr. Gerdes were constructed during the past twenty years at various locations throughout the country. During this long period certain materials and equipment have undergone a change in price of 100 per cent or over, and in some instances labor rates have varied as much. For example, the cost of water-wheel equipment increased about 100 per cent from 1915 to 1936, with fluctuations up and down during this period.

Comparisons of cost of such items of work as excavation, concrete, timber, structural steel, and equipment are worthless without taking into consideration the location and physical conditions at the site, material and labor prices prevailing at the time the work was done, amount and nature of work involved, weather conditions, construction plant facilities, special construction problems, and time available for doing the work.

Hydro plant design and construction as a whole cannot be standardized. Each development requires an independent design and appropriate construction methods, taking into consideration the conditions peculiar to the site in question and the purpose the plant is to serve. After such an analysis is completed and a well-balanced project prepared, what purpose would it serve to compare the various parts with those of another plant using a "kilowatt installed" yardstick? Only actual experience on such work can demonstrate to the designer and constructor the complexities of work of this nature. The power house itself is but one factor entering into the economic justification of the development as a whole. The physical conditions at the power site, land and water rights to be acquired, stream flow and head available, transmission distance, railroad and highway changes, characteristics of the load to be served, cost of generation of a like amount of power by other means, and financial market conditions are only a few of the many important factors that must be taken into consideration in a study of the economic justification of a project.

Experienced engineers will not be misled by improper comparisons of non-comparable data, but such comparisons may be improperly used by uninformed persons. Therefore, the advisability of publishing information of this character is questionable unless verified by a thorough and careful analysis.

L. N. Reeve, M. Am. Soc. C.E.

Boston, Mass.

To the Editor: The amount of labor involved in preparing the data shown in Mr. Gerdes' paper is tremendous. In this case, the result is worth the effort. Many engineers will not like the results, because they show comparisons of designs not always to the advantage of the designers. It is to be presumed that the figures are as nearly comparable as an astute, able, and dispassionate engineer can make them.

On the one hand, there will always be local conditions which either facilitate or make more difficult the design and construction of a water power plant. These conditions can hardly be reflected in the figures shown. On the other hand, it is hard to believe that they can be the cause of the great spread of some of the costs. The writer made an extended study of one of the plants reported before application was made for a federal permit. Considerable time and money were spent in studying various alternate sites, types of construction, sizes and types of machinery, and other factors.

The fact that Mr. Gerdes' figures for this plant show lower costs than the trend lines may be an indication that the preliminary work was well worth while, even though engineering costs are not included in the analysis. Owners are often extremely loath to spend thousands of dollars in preliminary studies, in spite of the fact that those studies may easily save many times their cost. Also, sometimes there may be a feeling that it does not matter what the job costs, because the rates for the output will be based on the actual cost and not on the minimum cost required to provide the service. There may be some dispute about the use of cost per kilowatt capacity as a basis for comparison. Since it is load-carrying ability that is desired in the construction of any power plant, it seems logical to use that for comparison of designs. Mr. Gerdes' argument for this unit is sound.

F. G. Switzer, Assoc. M. Am. Soc. C.E.
Professor of Mechanics and Hydraulic Engineering, College of Engineering, Cornell University

Ithaca, N.Y.

Cantilever Deflection Formulas

To the Editor: In reviewing the comments on my article on "General Formulas for Deflections of Cantilevers," in the July issue, I wish to thank the commentators, especially A. W. Fischer, David A. Molitor, and Prof. Joseph A. Wise, for their splendid discussions on this problem. Their methods and mine are all different, yet the results (including Mr. Molitor's solution, if we change his value of "E" to 29,000,000 to agree with that used by the others) are very close. My comments on their methods are as follows.

For the concentrated load Mr. Fischer does not show the work involved in the algebraic moment-area method to get his answer of 36.8 in. This method resolves itself to my Eq. 1, and my answer of 37.0 is a slide-rule computation. The solution for the deflection due to the uniform load is done very ably by the slope deflection method, giving a total deflection of 72.81 in. This is about 1 in. less than mine but involves considerably more work.

In his first paragraph Mr. Molitor disagrees with several authorities who state the moment-area method is best suited for the solution of deflection of cantilevers. Although Professor Mohr's Work Equation has stood the test of time, in this case its application is somewhat longer and more involved than mine and, like my solution, gives an answer a trifle high due to the curve assumption as stated by Mr. Molitor.

Professor Wise's solution is another type of algebraic solution of the moment-area method. His Eq. 2 is identical with my Eq. 1, if we substitute $l = nl_1$, in my equation and reduce $n^3 - (n-1)^3$ to $1 + 3n(n-1)$. From this I surmise that my Eqs. 2 and 3 may combine to equal Eq. 1 by Professor Wise, although I have not proved it.

My Eqs. 1, 2, and 3 are exact, their derivations are easy, and their application is simple and rapid. However, the assumption of the distribution of the load as shown on my Fig. 2(*b*) is not exact, and this leads to a larger deflection due to uniform load, Eq. 2. Therefore for an exact result the deflection by Eq. 2 must be reduced by the deflection due to the dotted triangles, Fig. 2(*b*), and this can be done by the moment-area method.

For equal lengths Eqs. 1, 2, and 3 are rather simple series problems in which any term "n" can be found very readily. When the lengths are unequal, merely change the limits of integration and solve as follows.

To find the deflection of a cantilever for a concentrated load "P" where *a*, *b*, *c*, *d*, *e*, are any proportion of the length "*l*" (see Fig. 1):

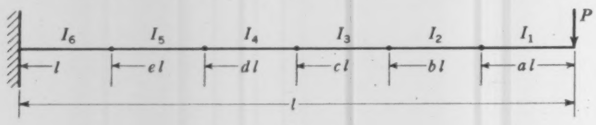


FIG. 1

$$\Delta_1 = \frac{1}{EI_1}\int_0^{al} Px^2\,dx + \frac{1}{EI_2}\int_{al}^{bl} Px^2dx + \frac{1}{EI_3}\int_{bl}^{cl} Px^2dx + \ldots \text{ and}$$

$$\Delta_1 = \frac{Pl^3}{3E}\left(\frac{a^3}{I_1} + \frac{b^3 - a^3}{I_2} + \frac{c^3 - b^3}{I_3} + \frac{d^3 - c^3}{I_4} + \frac{e^3 - d^3}{I_5} + \frac{1 - e^3}{I_6}\right) \quad \ldots\ldots [1A]$$

If $I_1 = I_2 = \ldots I_n$, then $\Delta_1 = \frac{Pl^3}{3EI}$

Similarly for uniform load of W

$$\Delta_2 = \frac{Wl^3}{8E}\left(\frac{a^4}{I_1} + \frac{b^4 - a^4}{I_2} + \frac{c^4 - b^4}{I_3} + \frac{d^4 - c^4}{I^4} + \frac{e^4 - d^4}{I_5} + \frac{1 - e^4}{I_6}\right) \quad \ldots\ldots\ldots [2A]$$

And for load increasing uniformly from zero at free end to $\frac{2W}{l}$ at fixed end (total load $= W$)

$$\Delta_3 = \frac{Wl^3}{15E}\left(\frac{a^5}{I_1} + \frac{b^5 - a^5}{I_2} + \frac{c^5 - b^5}{I_3} + \frac{d^5 - c^5}{I_4} + \frac{e^5 - d^5}{I_5} + \frac{1 - e^5}{I_6}\right) \quad \ldots\ldots\ldots [3A]$$

This is the same method I employed in my original article, and it is apparent that Eqs. 1*A*, 2*A*, and 3*A* are identical with Eqs. 1, 2, and 3 of that article.

R. REUBEN KOHN
Associate Engineer, Bureau of
Yards and Docks, Navy Department

Washington, D.C.

Settlement Studies and Field Conditions

TO THE EDITOR: Raymond F. Dawson's paper on "Settlement Studies on San Jacinto Monument," in the September issue, and subsequent discussion present various facts on the subject of practical soil mechanics that seem worthy of careful thought.

Mr. Dawson states, "The studies...have already provided valuable data on the correlation of laboratory and field results." The San Jacinto monument is one of the rare types of field problems in which loading and subsurface conditions closely approximate assumptions used in tests and calculations. Here one is justified in expecting a logical correlation between calculated and actual settlements. This is in contrast to the majority of cases where settlement calculations can be related to field conditions only by judgment based on wide experience.

The tests and calculations used by Mr. Dawson are simple, fundamental, and in common use—perhaps, in fact, too common use. They can either be a blessing or a curse, depending on the user. After continually observing the application of settlement calculations, it is evident to me that the estimation of the accuracy of results is all important. This estimate is the big gap between theory and actual practice—a gap that can only be spanned with a thorough knowledge of the behavior of soils, and of the buildings that are to rest upon them.

Later in the article Mr. Dawson states that, "Much of the credit for this research goes to the architect, engineer, and contractor on the monument, all of whom actively cooperated..." This statement will be significant to most foundation engineers. Practical soil mechanics and foundation engineering will advance and take their economic place in the construction fields only through cooperation between the architect, structural engineer, and foundation engineer. At the present time several factors often hinder this desirable association.

First, there are the engineers and architects who by nature oppose anything that seems "new" and fail to see why procedures of many years should be changed. Of course settlement analyses, and particularly the proportioning of footings for uniform settlement, are not new. The science is at least old enough to allow the existence of ranking engineers equipped with the empirical data and experience required to apply theoretical methods.

Second, there is another group of engineers with the unfortunate opinion that settlement analysis is still a matter of double integrals and Greek letters. This attitude produces either a distrust or lack of knowledge of the value of such analyses in everyday practice. Unfortunately too many soils engineers are abetting this point of view. This is due partly to the emphasis placed on research over practical soil mechanics in most books and periodicals. Blame must also be placed on soils engineers who, either through misguidance or a desire to hide lack of practical experience, emphasize theory.

The future of settlement analyses depends upon the acceptance of existing successful rational methods involving experience, empirical data, and calculation. They must be presented in a way that will inspire the trust of architects, engineers, and owners.

ROBERT W. HASELWOOD, Jun. Am. Soc. C.E.
With R. V. Labarre, Consulting
Foundation Engineer

Los Angeles, Calif.

A Thought from the Orient

TO THE EDITOR: Lin Yutang's book, *The Importance of Living*, described as "too human to be called philosophy," contains the following passage on page 163: "...American engineers in building bridges calculate so finely and exactly as to make the two ends come together within one-tenth of an inch. But when two Chinese begin to dig a tunnel from both sides of a mountain, both come out on the other side. The Chinese's firm conviction is that it doesn't matter so long as a tunnel is dug through, and if we have two instead of one, why, we have a double track to boot. Provided you are not in a hurry, two tunnels are as good as one, dug somehow, finished somehow and if the train can get through somehow...."

Do we hear anyone trying to make an analogy between the Chinese tunnel-builders and some of the government-builders in the world today? Perhaps all should be included among those referred to in the epigram of Chang Ch'ao, which is quoted at the beginning of the same book, "Only those who take leisurely what the people of the world are busy about can be busy about what the people of the world take leisurely."

New York, N.Y. GAVIN HADDEN, M. Am. Soc. C.E.

Practical Application of Soil Mechanics Theories at World's Fair Site

TO THE EDITOR: It was my privilege to work alongside Mr. Freeman (author of "A Practicing Engineer Looks at Soil Mechanics," in the December issue) on one of the largest projects in New York City—a project that has been created only by the practical application of the theories of soil mechanics. My part in this work was to carry out, both in design and construction, the recommendations of the foundation consultants for the work.

Late in the year 1935 Mr. Freeman's firm was retained to make a study of a waste area, involving over 1,200 acres in the city of New York, and to report whether it was possible and practical to reclaim this area primarily for future use as a park and, incidentally, as a possible site for the New York World's Fair of 1939.

The proposed site was the Flushing Meadows—a portion of which had been used as an ash dump for some thirty years by the city. The following description of the subsurface conditions of the area is quoted from the report of Mr. Freeman's firm: "The area, generally, is underlain with a deep alluvial deposit of clay and silt, below which are interbedded layers of sands, gravels, and clays extending to considerable depths. The natural surface of the meadow is vegetable growth and decayed vegetable formation, at some points several feet in thickness. Immediately below the surface covering is a stratum of clay and silt, which extends approximately to elevation −60 along the center, and for nearly the entire length of the meadow. Below this is a bed of medium sand, having a minimum thickness of about 20 ft and increasing in thickness toward the lateral margins of the meadow, where the clay and silt deposit reduces substantially in depth and the sand approaches the surface."

After a very careful study of the site, which included only about 50 borings in the entire area, together with undisturbed samples of the subsoil, Mr. Freeman's firm reported that it was not only possible, but practical to convert this area for the required purposes. Their report indicated that if certain fundamental rules of soil mechanics were carefully observed, the entire area might successfully and practically be improved.

The first step in this improvement was necessarily to provide for a blanket over the entire marsh land, and to provide this blanket it was decided to use over seven million yards of the ash fill. This grading contract was carefully drawn to include the necessary restrictions demanded by the fundamentals of soil mechanics.

The design of each of the 5 bridges in the area—and particularly the design of the approaches to each bridge—was based entirely upon the theories of soil mechanics. The fill in the approaches was limited, generally to a 3 per cent slope, with a 4 per cent slope as the maximum in any case, and at no point was a surcharge of over 4 ft permitted. It is interesting to note that there has been no apparent movement in any of the structures and no serious movement of any of the grading.

I have given a short résumé of a very recent practical problem in soil mechanics which has proved, without doubt, that the principles of soil mechanics properly applied in design, and carefully adhered to during the construction period, will definitely solve foundation problems which, in the recent past, were approached by "rule of thumb methods." Soil mechanics also provides the means for the reclamation of many areas which, under the old methods, it would be, to say the least, hazardous to attempt.

Irving V. A. Huie, M. Am. Soc. C.E.
Commissioner, Department of
Public Works

New York, N.Y.

Economical Planning of Hydroelectric Plants

To the Editor: In his article in the December issue, Mr. Larned has given an excellent discussion of factors to be considered and studies to be made to assure the soundness, economic and technical, of a hydroelectric plant or project. He has done a fine job in showing the reasons why a modern hydro project has to be planned as part of a system rather than as an isolated unit. This fact unfortunately is not generally appreciated. Mr. Larned also shows that the intricacies of the problem are usually such as to require the consideration of specialists. With that one can readily agree. He does not, however, point out what I am sure he knows—that the integration of the combined ideas and efforts of these specialists is a job for someone with a broad background of experience in power system design and operation.

Mr. Larned also points out the present weakened economic position of hydro power and the great need of economical planning, designing, and construction of hydro developments. He concludes that a hydro development is advisable only if its power cost meets that produced either by a steam plant or the cost of purchased power. It seems to me that this conclusion is not quite safe. I would go further and say that it is essential that hydro power should not only meet the power costs of other sources, particularly fuel, but that it should do even better. My reasons are (1) a hydro development is naturally a long-term commitment; (2) steam and other forms of power production are progressing at such a rate that obsolescence may overtake the hydro project well before the period allowed; and (3) the ill effects of hydro power on the national economy. Hence, unless hydro-generated energy can show substantial present or immediate advantages over other methods of generation, it appears unsafe to develop it instead of steam power.

Mr. Larned states that "The gross revenue to be obtained from the plant can be determined from the prospective rates to be charged for the power." A simpler method is to place on the positive side the value over a period of years of the primary, secondary, and dump capacity and energy, and on the negative or expense side to place the total of the fixed charges, including interest, depreciation, taxes, insurance, and all the operating expenses. Then to strike a balance, one need only to find the difference between these two, which is the return over and above the fixed charges. Or one can merely deduct from the value side all the expenses except fixed charges and arrive at a figure of return on the investment. If it is expected that during the life of the project some of these values will be subject to change, the entire period of life should be broken up into a series of intervals and proper values used for each of the intervals.

Very appropriately Mr. Larned emphasizes the necessity of a long-term load study, including the projection of future requirements to determine the need of capacity in the first place, the quantity of capacity, and the type of capacity. Such a forecast is needed not only for capacity but in the study of the value of capacity previously mentioned. Studies that the writer has made indicate that it is an exceptional system that can show for the last ten years a load growth much in excess of 5 per cent compounded annually. This involves doubling in something like 14 years, which would be a husky growth. In his Fig. 1 Mr. Larned shows a greater rate of growth for the period 1934 to 1939. It would be interesting, however, to know whether his 1938 peak followed anything like his estimated normal trend and whether as of today it isn't actually considerably below the 1937 peak.

Philip Sporn, M. Am. Soc. C.E.
Vice-President, American Gas
and Electric Service Corporation

New York, N.Y.

Importance of Adequate Borings

To the Editor: The importance of adequate and sufficient borings and samples, discussed by Mr. Freeman in the December issue, cannot be overemphasized. The use of wash borings with dry samples as a basis for plotting the soil profile, and of more elaborate methods where undisturbed samples are required, can be properly planned only with a full understanding of the problem. Since a proper sampling program is essential to sound foundation design, I wish to add to Mr. Freeman's bibliography a bulletin published in 1937 by Harvard University, entitled "Exploration of Soil Conditions and Sampling Operations," by H. A. Mohr, Assoc. M. Am. Soc. C.E. This bulletin describes accurately the mechanics of modern sampling operations and discusses forcefully the dangers of inadequate or faulty soil explorations.

Mr. Freeman recommends that borings should be carried to sufficient depth. How deep is "sufficient depth"? Unless borings can be carried economically to hard bottom the answer obviously depends on many variables. Sufficient depth is determined by stress and strain, and these can be approximated for the purpose of boring specifications. For example, the enlightened proposed Boston Building Code suggests computing stress under a loaded area by considering the load carried down within lines making an angle of 60 deg with the horizontal. Whether you prefer Boussinesq, or Froehlich, or Griffith, or a concentration factor of three, or six, or some variation of your own, this 60-deg approximation is sufficiently close for outlining boring programs. In many cases excessive settlements have occurred, where borings carried to a depth equal to the diameter of the foundation have entirely failed to disclose the problem. In general it is safer to carry the borings two or three diameters below the bearing elevations. The depth for a specific case can be determined only by considering the size and type of structure, the approximate distribution of stresses, and the consistency of the soil encountered.

In Mr. Freeman's discussion of piles he states that tests by driving and loading single piles in good granular soil "may" be sufficient to establish their supporting values. A distinction should be made between dry and wet cohesionless materials. Their behavior is vastly different when penetrated by piles. It is the writer's opinion that in most cases the resistance to driving after a period of rest rather than the resistance to continued driving should be the criterion of resistance to the load of a structure. Yet pile formulas are generally used with penetrations under steady driving. The effect of rest in dry cohesionless material is probably negligible, but piles driven into the saturated fine sand underlying the Flushing Meadows on Long Island have been greatly affected by short periods of rest. When driving was recommenced after a rest of as little as two minutes, the number of blows increased by 10 per cent for some piles and by 500 per cent for others. Some which were moving at the rate of about 20 blows of a Vulcan No. 1 hammer per foot failed to move an inch under fifty blows following a rest of three or four minutes. What is the supporting value of such a pile which penetrates a foot under four blows in continuous driving, and then requires twenty blows for the next foot after a brief rest? Driving formulas would allow about three tons. The writer would not hesitate to load it with 15 tons. A load test on such a pile would give more reliable information, but a rational safe load can only be selected by proper correlation of either load test or driving formula with the reliable knowledge of soil conditions only obtainable from an intelligently planned and executed boring program.

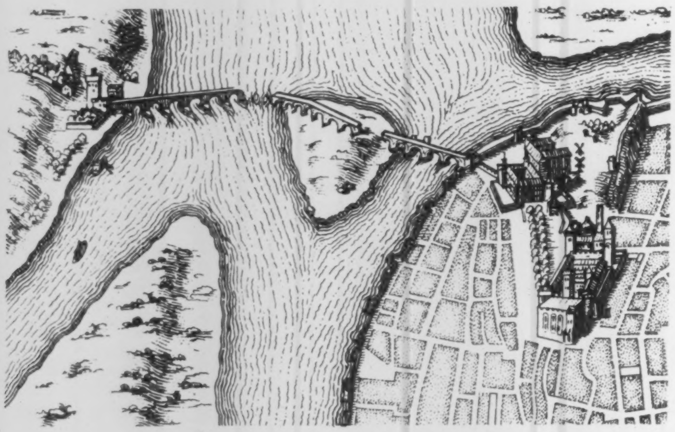
WILLIAM P. KIMBALL, Assoc. M. Am. Soc. C.E.
Assistant Professor of Civil Engineering,
Thayer School of Civil Engineering

Hanover, N.H.

The Avignon Bridge Legend

TO THE EDITOR: Few structures have been celebrated in song and legend more than the old bridge that once spanned the turbulent Rhone at Avignon, France (shown on the Page of Special Interest in the December issue). Only four of its original twenty-one paraboliform arches remain, mute evidences of the skill of little "Saint" Bénézet (or Benoît) the courageous young engineer who inspired the monumental undertaking nearly 800 years ago. The bridge was begun in 1178 and completed in 1188, several years after Bénézet's death. It suffered in war and in flood, until finally in 1670 the ice rendered it useless to any but antiquaries and artists.

The story of its inception is told in a priceless old document treasured in the Avignon archives. One version, a delightful sixteenth century mixture of fact and legend, I have translated below. The legend certainly puts our hero far too young to have accomplished what he did.



VIEW OF AVIGNON BRIDGE
Taken from Tassin's *Les Plans et Profils de Toutes les Principales Villes . . . de France,* 2d Part, Paris, 1638

The belief that Bénézet founded a religious order, the Fratres Pontis, or Brothers of the Bridge, is not held today by most historians. The question as to the official beatification or canonization of Bénézet is a hagiographic matter, which is beyond me and one on which modern ecclesiastical scholars are not at all dogmatic.

However, reference to any calendar of saints will show this engineer's name set down against April 14. Bénézet's name thus leads all the rest, but the list unfortunately stops right there. The translation of the bridge legend follows:

Pope Innocent IV tells how that a divinely inspired lad named Benoît constructed a work beyond human power. The young man was of Almillat, and was about twelve years old. One day while watching his mother's sheep he heard a voice saying "God protect you." When he heard the voice and saw no one he cried out weeping, "Who is the Lord who is speaking to me?" The same voice replied, "Don't be afraid, but be assured that I am able to do through you that which I am going to tell you about. Go, and make a bridge over the Rhône, and be certain that whatever is necessary God will accomplish."

Hearing this, he believed it, left his sheep, and started out not knowing whither he was bound. On the road he met a person who seemed to be a pilgrim, who saluted him with the words "I know where you are going, and I shall show you the way. In fact from the sixth to the ninth hour, that is within three hours from Almillat, he found himself at Avignon, a three day's journey. Having arrived there, the pilgrim said, "Here is the place to which you have been sent to build a bridge." He thereupon showed him the spot and how to build the bridge, and, after kissing him gave him his blessing and vanished from sight.

The young man, troubled because his companion had left him, after much hesitation entered Avignon. As he reached the market place a minstrel was singing before a huge crowd. He climbed up on a butcher's block and shouted, "Silence!" And the crowd, marveling, was still. "I have been sent here to build a bridge across the Rhône." To which they replied, "Where have you left the Antichrist who sent you? The task you talk of was impossible to Augustus Caesar, Julia, Octavius, and the emperor Charles the Great, but you are going to attempt it." And after giving him much sound advice they shaved his head and hustled him out of the city.

But three weeks later, on the advice of an angel, he returned to the city and found on the way a citizen in front of his door, haranguing a group of people who were listening intently, saying "Here is the boy who said he wanted to build a bridge." To which the boy replied, "What are you so astonished about? I am God's messenger. I pray you for the love of Christ give me material for the bridge." At which the citizens asked, "Do you intend to make it of stone?" He assured them that he did. "Then I'll give you the rock under the elm in front of my house." This was said in mockery, because the boulder was enormous, some thirteen feet long and seven feet wide. But the lad, confiding in our Lord's power, fell on his knees, made the sign of the cross on the stone, praying, "Lord help me." Then, his prayer finished, he took hold of the stone, which rose out of the ground so that he was able to push it to the bank of the Rhône. And with this miracle and several others the bridge was begun and in large part completed. The lad established at the end of the bridge a hospice. Soon after beginning the bridge he went to Rome to obtain from the Holy Father several indulgences for the benefactors of said bridge and hospice.

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Chairman, Department of Engineering
Drawing, School of Engineering,
Yale University

New Haven, Conn.

Filing Technical Material

TO THE EDITOR: My commendation on the happy thought to change the size of CIVIL ENGINEERING, announced so unobtrusively in the January issue!

This change in size will be a convenience to many readers who, like myself, clip articles of special interest for future reference. The variation in the size of technical journals makes filing rather awkward, and any step toward standardization in this respect is welcome. I am hopeful that one of these days most technical journals will be printed on letter-size paper, which will permit filing and binding in standard office equipment.

TRANSACTIONS and PROCEEDINGS are admirably suited for that purpose, and other society publications have followed your lead as to the size of paper.

With the vast range of topics covered in such periodicals, I find it best to file papers of interest and to bind each subject in book form when warranted, thus building up a library by topics instead of by the calendar. I recommend this method of filing as saving space and time for those whose engineering work is within definite limits.

ALFRED BRAHDY, M. Am. Soc. C.E.

New York, N.Y.

SOCIETY AFFAIRS

Official and Semi-Official

Spring Meeting to Be in Chattanooga, Tenn.

Southern City Preparing for Society Gathering on April 19–22

The next major event of general interest to the entire Society is the Spring Meeting in Chattanooga, Tenn., scheduled for April 19–22, 1939. Members attend the four yearly meetings of the Society for various reasons—social, technical, and recreational. And the meeting in Chattanooga will appeal on all three counts.

Chattanooga's historic interest centers around the Civil War. The city contains more than 2,000 monuments, and others are scattered over nearby Lookout Mountain and Missionary Ridge. The modern city is one of the South's important manufacturing centers, and its central location in the Tennessee Valley makes it a good starting point for trips to the many dams and hydroelectric installations in the area.

The Spring Meeting will be preceded by the usual meetings of the Board of Direction, by a Student Conference, and by a conference of representatives from Local Sections in this Meeting Region. The meeting itself will open officially on Wednesday morning, April 19, with a general session devoted to three different topics, instead of to a symposium on a single topic as is usually the case. In the morning there will be a paper on "Aluminum and Its Applications to Engineering Structures," and another on "Flood Control on the Mississippi River." The afternoon session will consider a subject most appropriate to the time and place—"Construction Program and Activities of the Tennessee Valley Authority." This session will close early in order to leave time for a motor trip to Lookout Mountain (where was fought "The Battle Above the Clouds") and to other points of interest in the vicinity.

Three half days will be devoted to the technical program—Thursday morning and afternoon, and Friday morning. Six of the Society's Technical Divisions will present programs, as follows:

Soil Mechanics and Foundations Division

Thursday Morning

Foundation Exploration and Geologic Studies—Chickamauga Dam
Foundation Treatment—Chickamauga Dam

Thursday Afternoon

Report of Division Committee on Soil Sampling and Testing
Foundation Treatment—Guntersville Dam

Surveying and Mapping Division

Thursday Morning

Trends in Boundary Surveying
The Need for Topographic Maps in Regional and Local Planning

Thursday Afternoon

Atlanta City Survey
Organization of TVA Surveying and Mapping Activities
Stereoscopic Plotting Instruments in Topographic Mapping
Exhibit of Precise Surveying and Mapping Instruments, with Illustrations of Results Obtained and Methods Applied

Power Division—Symposium Arranged by Joint Committee on Masonry Dams

Thursday Morning

Masonry Dams—Basic Design Assumptions
Design of Gravity Dams
Design of Arch Dams
Design of Special Dams

Thursday Afternoon

Geology of Dam Sites
Determination of Elastic Properties of Foundation Rock
Methods of Improving Foundation Rock

Highway Division

Friday Morning

Soil Stabilization in South Carolina
Construction of Highway Embankments Across TVA Reservoirs
Low-Cost Highway Construction in Alabama

Construction Division

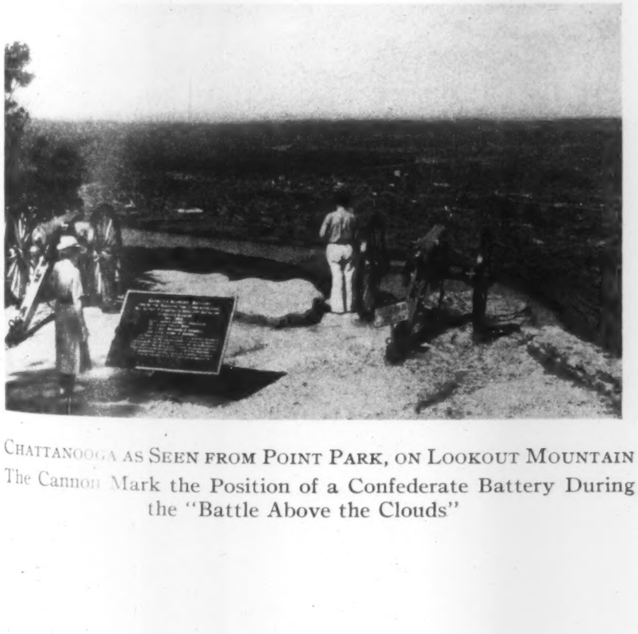
Friday Morning

Time Studies and Cost Accounting on Large Construction Operations
Principles of Plant Layout for Large Dams
Principles of Plant Layout for Buildings

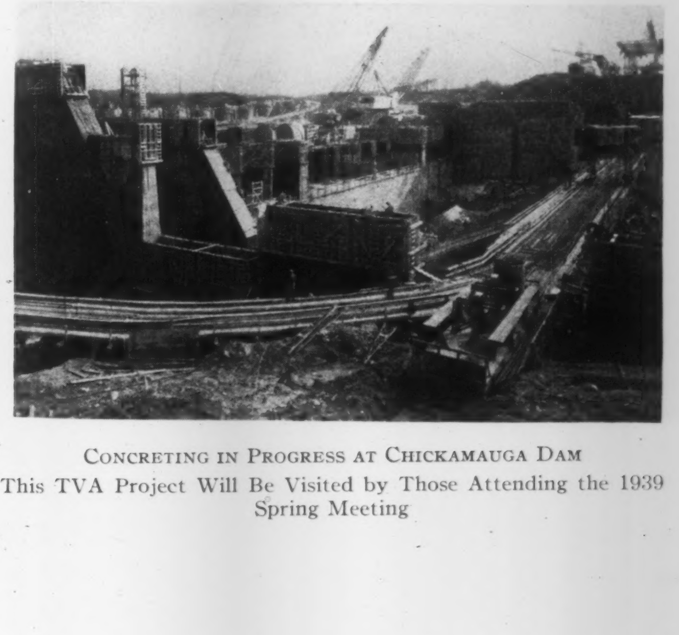
On Friday morning, also, the newly organized Hydraulics Division will make its first appearance on a Society meeting program. Plans for its session are still in preparation and will be announced in the April issue.

Plans for Social Functions

While the technical features probably exert the strongest appeal in bringing members to a meeting, the social features also have a definite drawing power. On Wednesday evening there will be a



Chattanooga as Seen from Point Park, on Lookout Mountain
The Cannon Mark the Position of a Confederate Battery During the "Battle Above the Clouds"



Concreting in Progress at Chickamauga Dam
This TVA Project Will Be Visited by Those Attending the 1939 Spring Meeting

dinner for members, ladies, and guests, followed by an illustrated address on the National Parks of the United States, with special emphasis on the Great Smoky Mountain National Park. On Thursday evening, members, ladies, and guests will go to one of the nearby country clubs for dinner and an evening of dancing and entertainment.

Besides taking part in these two evening functions, the ladies will enjoy social events planned for them alone. Following assembly and welcome by the Ladies Committee on Wednesday morning, the visiting ladies will gather for a luncheon. In the afternoon they will go with the members on the motor trip to Lookout Mountain previously mentioned. On Thursday afternoon, while the members are engaged in technical meetings, the ladies will go on a sightseeing tour of Chattanooga and vicinity, following which there will be a tea.

INTERESTING EXCURSIONS ARRANGED FOR FRIDAY AND SATURDAY

As the technical program comes to an end at noon on Friday, an excursion has been arranged for the afternoon of that day. In this ladies as well as members will participate. The destination will be the Chickamauga Dam, where the vast construction program now under way will offer an interesting and varied opportunity for inspection.

On Saturday, there will be a choice of three inspection trips, as follows:

1. Tennessee Electric Power Company Dams and the Hiwassee Dam of the TVA
2. Dams of the Aluminum Company of America—Tapoco, Calderwood, and Santeetlah
3. Guntersville Dam of the TVA

For those who desire, arrangements will be made for a trip to the Great Smoky Mountain National Park.

The Local Committee on Arrangements, which has had a large part in arranging the program, is headed by Lee G. Warren, president of the Chattanooga Section of the Society, as chairman; J. I. Perrey is vice-chairman; and C. B. Coe, secretary of the Section, is the executive secretary-treasurer of the committee. Space does not permit giving the complete personnel of the local committee in this preliminary announcement. However, this personnel will be listed in full in the detailed program of the Spring Meeting, to be published in the April issue of CIVIL ENGINEERING. Headquarters will be at the Hotel Patten. The committee is to be complimented not only on the excellence of the program but also on its efforts to obtain the wide interest of members in attending the meeting.

Meeting of Outgoing Board of Direction—Secretary's Abstract

ON JANUARY 16 and 17, 1939, the outgoing Board of Direction met at Society Headquarters, with President Henry E. Riggs in the chair; and present George T. Seabury, Secretary; Past-Presidents Tuttle and Mead; Vice-Presidents Bellinger, Gowdy, Noyes, and Pirnie; Directors Agg, Anderson, Ayres, Bres, Davis, Dean, DeBerard, Finch, Harrington, Hidinger, Hill, Legaré, Myers, Needles, Proctor, Root, Shea, Stanton, Tiffany, and Treasurer Hovey.

Board Personnel

Through the deaths of Past-President Hill and Director Arneson there would have been two vacancies on the Board but for the provision in the Constitution that the Board shall always include the two latest living Past-Presidents. Upon the death of Past-President Hill, therefore, Past-President Tuttle automatically became a Member of the Board in his place. Immediately after the roll call, and a moment of silence in respect to the memory of the deceased officers and of two Honorary Members, Robert Ridgway and W. L. Darling, the Board proceeded to fill the vacancy caused by the death of Director Arneson, Representative of District 15. Edward S. Bres who by election of the Society was to take office at the expiration of Director Arneson's term, was elected by the Board to fill the unexpired term.

There was, therefore, one hundred per cent attendance by the Board members, an unusual condition, especially during the winter when sickness is apt to interfere in one or two cases and spoil the record. Full attendance at the winter meeting is especially desirable because it is ordinarily the most important and most intensive of the year. Pending matters are frequently completed, and the

1938 BOARD OF DIRECTION OF THE SOCIETY

Starting at the near corner of the table and proceeding clockwise: James K. Finch, Director, District 1; Raymond A. Hill, Director, District 11; Carlton S. Proctor, Director, District 1; C. E. Myers, Director, District 4; L. L. Hidinger, Director, District 14; R. C. Gowdy, Vice-President, Zone III; Thomas E. Stanton, Jr., Director, District 13; Thomas R. Agg, Director, District 16; T. Keith Legaré, Director, District 10; Malcolm Pirnie, Vice-President, Zone I; L. E. Ayres, Director, District 7; Arthur W. Dean, Director, District 2; William J. Shea, Director, District 1; E. N. Noyes; Vice-President, Zone IV; E. S. Bres, Director, District 15; Enoch R. Needles, Director, District 1; J. E. Root, Director, District 9; Arthur W. Harrington, Director, District 3; James A. Anderson, Director, District 5; W. W. DeBerard, Director, District 8; Otis E. Hovey, Treasurer; Carolina Crook, Secretary to Mr. Seabury; George T. Seabury, Secretary; Henry E. Riggs, Past-President; R. K. Tiffany, Director, District 12; R. P. Davis, Director, District 6; L. F. Bellinger, Vice-President, Zone II; Daniel W. Mead, Past-President; and Arthur S. Tuttle, Past-President.

slate is cleaned as far as possible for the beginning of a new year, and the advent of a new Board of Direction to administer Society affairs. By invitation, members of the Incoming Board also were in attendance as auditors, thus gaining some insight into pressing Society matters, in advance of their undertaking officially to be responsible for Society management.

Recognition of Past-President Hill and Director Arneson

A committee, appointed to prepare suitable resolutions regarding the loss of Past-President Louis C. Hill, submitted a resolution which was unanimously adopted, in the form as given elsewhere in this issue.

Similarly, a resolution re Edwin P. Arneson, former Director, was prepared and approved, as given on another page.

Annual Report

Draft of the Annual Report of the Board was presented. After discussion and some revisions, the report was approved for publication. It will appear in the Society Year Book for 1939, to be issued as Part 2 of the April Proceedings.

Society Action Involving National Policies

Upon recommendation of the Executive Committee, the Board considered it advisable to provide safeguards in the approval or publication of any action by Society units affecting national policies. Accordingly it adopted resolutions covering this matter, as given in full on an adjacent page.

Assignment of Committees

Consistent with the new alignment of Society Division and Committee work, the following research committees having to do with water were assigned to the Hydraulics Division:

Committee on Flood Control
Committee on Flood Protection Data
Committee on Hydraulic Research
Committee on Meteorological Data
Committee on a National Water Policy

The committee on Stresses in Railroad Track, since it did not fit into any of the Technical Divisions, was assigned to report directly to the Committee on Technical Procedure.

Amendment to By-Laws—Technical Department

Article IV, Section 10 of the By-Laws, dealing with the set-up of Technical Divisions and the Committee on Technical Procedure, was revised in certain details. These changes require the executive committee of each Division to select its own chairman and vice-chairman; decrease the Board's representation in the Committee on Technical Procedure; and provide an executive committee and chairman therefor, with appropriate duties.

Districts and Zones

Following the recommendations of its Committee on Districts and Zones, the Board adopted several new boundaries to apply in 1939, primarily in consequence of the establishment, last year, of new Local Section boundaries, and on the ground of greater mutuality of interest and of increased facility of communication. A separate item and map elsewhere in this issue cover the details.

Local Section Meetings

In order to clarify the requirement that the Local Sections must hold five meetings during the year, the Board reaffirmed its previous ruling defining such meetings, as follows: "Meetings of subsections and each session, morning, afternoon, and evening, of all-day meetings of a Section will be considered as technical meetings, when the subjects presented comply with the (previous) definition" of a technical meeting.

Salaries

Report of the Committee on Salaries was received. Extended discussion disclosed the Board's great interest in this problem. The promulgation of a salary schedule for employed engineers, as a result of so many years' study, was felt to mark distinct progress. It was hoped that its use in the future will equal that which has been accorded to similar Society studies relating to fees for consulting work. The Board authorized the publication of the Committee's "Grading Plan and Compensation Schedule," covering the first three professional grades for civil engineers, and is desirous of informed, constructive comment. (This report was printed in the February 1939 Civil Engineering, page 111 et seq.)

American Engineering Council

A report was received from the Board committee appointed to study American Engineering Council. At the previous request of the Board other national societies similarly interested had also appointed representatives. The study thus developed into a joint committee effort, with twenty members. An extensive questionnaire sent out by the Committee elicited replies from over fifty representative engineers in various groups. The Committee's report dealt with the need, functions, and preferable operation of Council; and with the desirable relation of the constituent national societies as members of Council. Without making any commitment as regards the suggested financial support, the Board adopted the recommendations involving the approved functions of Council.

The Board continued its membership in Council, providing reduced financial support for 1939.

International Meeting, September 1939

The Special Committee on Arrangements reported on the Society Fall Meeting, set for the early part of September in New York City, in connection with the New York World's Fair. This meeting will have an international character, invitation having been given and accepted whereby the Society will be host to the Institution of Civil Engineers (of Great Britain) and the Engineering Institute of Canada. A tentative program was presented, showing a comprehensive arrangement of technical meetings, social events, inspections, and sight-seeing to occupy most of the week beginning September 4, 1939. It is planned that all the technical as well as some of the social features of the meeting will center at Columbia University. In a similar manner the supplementary phases of this international gathering will revolve about the New York World's Fair.

In view of the courtesies extended by the University, in generously providing facilities for the meeting, official thanks were ordered to be conveyed to Nicholas Murray Butler, President of Columbia University.

Extension of Time for Transfer

On account of the lack of opportunities during recent years some Juniors reach the age limit of 33 before they have acquired quite the necessary experience to qualify them for transfer to the corporate grade. Rather than to drop these men from membership because of the age limit, the Board decided that, effective during 1939, applications for transfer received from Juniors after their 32nd and before their 33rd birthdays should be held pending when necessary until their 34th birthday, thus giving them one extra year in which to overcome their handicap.

Student Chapters

Report was received from the Committee on Student Chapters, giving interesting details as to their activities and their problems. Excerpts from this report will be found elsewhere in this issue.

Budget

Recommendations were received from the Executive Committee covering the Society budget for 1939. After extensive discussion, the various items were adjusted to bring the expenditures within the Society income. As thus balanced, the budget was approved for transmission to the Incoming Board.

Miscellaneous

Reports of various committees and officers were received and other routine matters were presented to the Board, each with appropriate action.

Adjournment

After remarks by those members of the Board whose terms were terminating, the Board adjourned.

Appointments of Society Representatives

James K. Finch, M. Am. Soc. C.E., has been appointed to serve as one of the Society's representatives on the Alfred Noble Prize Committee to fill the unexpired term of the late Robert Ridgway, Past-President and Hon. M. Am. Soc. C.E.

George L. Lucas, M. Am. Soc. C.E., has been appointed the Society's representative on the Committee of the U. S. Department of Commerce on Paving Brick to fill the vacancy caused by the death of Bernard L. Crozier, M. Am. Soc. C.E.

Comprehensive Report on Earthquakes Available

Publication of the paper on "Earthquakes and Structures" in the December 1938 issue of Proceedings has aroused new interest in the comprehensive report on earthquakes which was prepared by a special committee of the Society between 1923 and 1928 and which is now available for reference at the Engineering Societies Library, 29 West 39th Street, New York, N.Y. The following statement of its contents, taken mainly from the introduction, is presented for the benefit of those who may wish to consult it.

The report was designed to constitute a summation of knowledge regarding earthquakes. It consists of 4 chapters, totaling 487 typewritten pages, and 7 appendices, totaling 346 typewritten pages, together with 364 photographs and a large number of drawings. Chapter I contains definitions, a historical review of important earthquakes, discussions of the cause, frequency, and distribution of quakes, and detailed descriptions of the various types of earth movements in an earthquake. Chapter II describes the Japanese earthquake of September 1, 1923; Chapter III gives 244 pages to "Damage to Engineering Structures by Earthquakes"; and Chapter IV (which with its appendices comprises well over half the report) treats of "The Design of Structures to Resist Earthquakes." The titles and authors of the appendices are:

STREET IN YOKOHAMA, FOLLOWING THE EARTHQUAKE OF SEPTEMBER 1, 1923

One of the 364 Photographs Included in the Report of the Special Committee on Effects of Earthquakes on Engineering Structures

"Earthquake Stresses and Dynamical Theory," by Leander Miller Hoskins, professor emeritus of applied mathematics, Stanford University, California. An abridgment of this part of the report was incorporated in the paper by Professor Hoskins and John D. Galloway, M. Am. Soc. C.E., published in the December 1938 Proceedings.

"Stresses in a Vertical Elastic Road when Subjected to a Harmonic Motion of One End," by Profs. Joseph Le Conte and John E. Younger, of the University of California, Berkeley, Calif.

"Natural Periods of Vibration of a Single-Span Four-Story Bent with Rigid Floors," by R. R. Martel, M. Am. Soc. C.E.

"Dynamic Behavior of a One-Story Bent Subject to Simple Harmonic Motion," by R. R. Martel, M. Am. Soc. C.E.

"The Earthquake Resistance of Towers and Chimneys," being a portion of *Die Erdbebensicherheit von Bauwerken*, by Dr. Eng. Rudolph Briske, of Berlin, Germany.

"Construction of Earthquake-Proof Frame Buildings," by Dr. T. Naito, professor of architecture, Waseda University, Tokyo, Japan.

"A Review of the Treatise of Dr. Naito," by W. M. Wilson, M. Am. Soc. C.E.

The report is made up partly of material supplied by the committee and partly of extracts from other papers and reports. In addition, use was made of a large amount of data supplied by engineers throughout the United States and Japan, in response to requests. Four members of the committee were Japanese, and under their supervision elaborate reports containing photographs and plans were brought together and forwarded to the American members, together with much material from the Civil Engineering Society of Japan and the Imperial Earthquake Investigation Council. Papers originally in Japanese were translated with the assistance of the late James Francis Abbott and of Francis M. Hayashi, electrical engineer, of San Francisco.

Personnel of the committee included J. D. Galloway as chairman, and Henry D. Dewell, Frederick H. Fowler, John Millis, C. H. Snyder, and C. B. Wing. The Japanese subcommittee was under the chairmanship of Dr. Isami Hiroi, until his retirement, and was later headed by Hyotaro Inagaki. Its other members were Masayoshi Kabashima, Dr. Mikishi Obe, and Tashiro Shiraishi.

Board of Direction Commemorates Late Director E. P. Arneson

When Edwin P. Arneson died on December 7, 1938, his three-year term as Director from District 15 was almost completed. During his service, he had won the regard of the Board for his ability and his warm human attributes. The Board therefore authorized a resolution in his memory, which was unanimously adopted at its January 16 meeting, as follows:

Whereas the Board of Direction of the American Society of Civil Engineers has been shocked to learn of the death, on December 7, 1938, of its fellow Director, Edwin P. Arneson; and

Whereas Mr. Arneson's death while still in the prime of life has removed one who had ahead of him many years of usefulness to the Society and to the profession at large; and

Whereas the Board has found him to be a most active and valued co-worker in all its affairs, with the interests of the Society always at heart; and

Whereas his character and friendliness have earned for him the esteem and affection of his fellow members of the Board,

Now, therefore, be it resolved by this Board, assembled in meeting at New York City this day, January 16, 1939, that it records its warm regard for its late associate, and its deep sorrow for his loss; that it extends its sympathy to his family, and directs that this resolution be spread on the minutes of the Board, and that a copy be forwarded to Mr. Arneson's family.

Sanitary Engineering Division Adopts Resolution on Eligibility of Engineers to Serve as Health Officers

The following resolution, commenting on a committee report to the U. S. Conference of Mayors which recommended that only physicians be eligible to serve as health officers in American cities, was unanimously adopted by the Sanitary Engineering Division on January 19, 1939:

Whereas, it has come to the attention of the Executive Committee of the Sanitary Engineering Division of the American Society of Civil Engineers that a report of the National Health Officers Qualifying Board to the Conference of Mayors has recommended "that only physicians be eligible to serve as Health Officers in American cities," and

Whereas, there are a substantial number of public health officers with established records of proficient service who have been basically trained as sanitary engineers, and

Whereas, the American Public Health Association, a leading organization of medical health officers, has within its membership many leaders who were trained as engineers, and has from time to time seen fit to recognize such sanitary engineers by their elections to the presidency of this important national association of health officers, and

Whereas, the recommendation to the Conference of Mayors, above referred to—namely, limiting the field of health officers to physicians—is inconsistent with proven public health practice, and is illogical,

Therefore be it resolved that the Sanitary Engineering Division of the American Society of Civil Engineers goes on record as pointing out the fallacy of such recommendations, and that a copy of this resolution be sent to the Conference of Mayors.

The resolution was duly transmitted to the executive secretary of the Conference of Mayors, through the Secretary of the Society, on January 23.

Changes in Boundaries of Districts and Zones

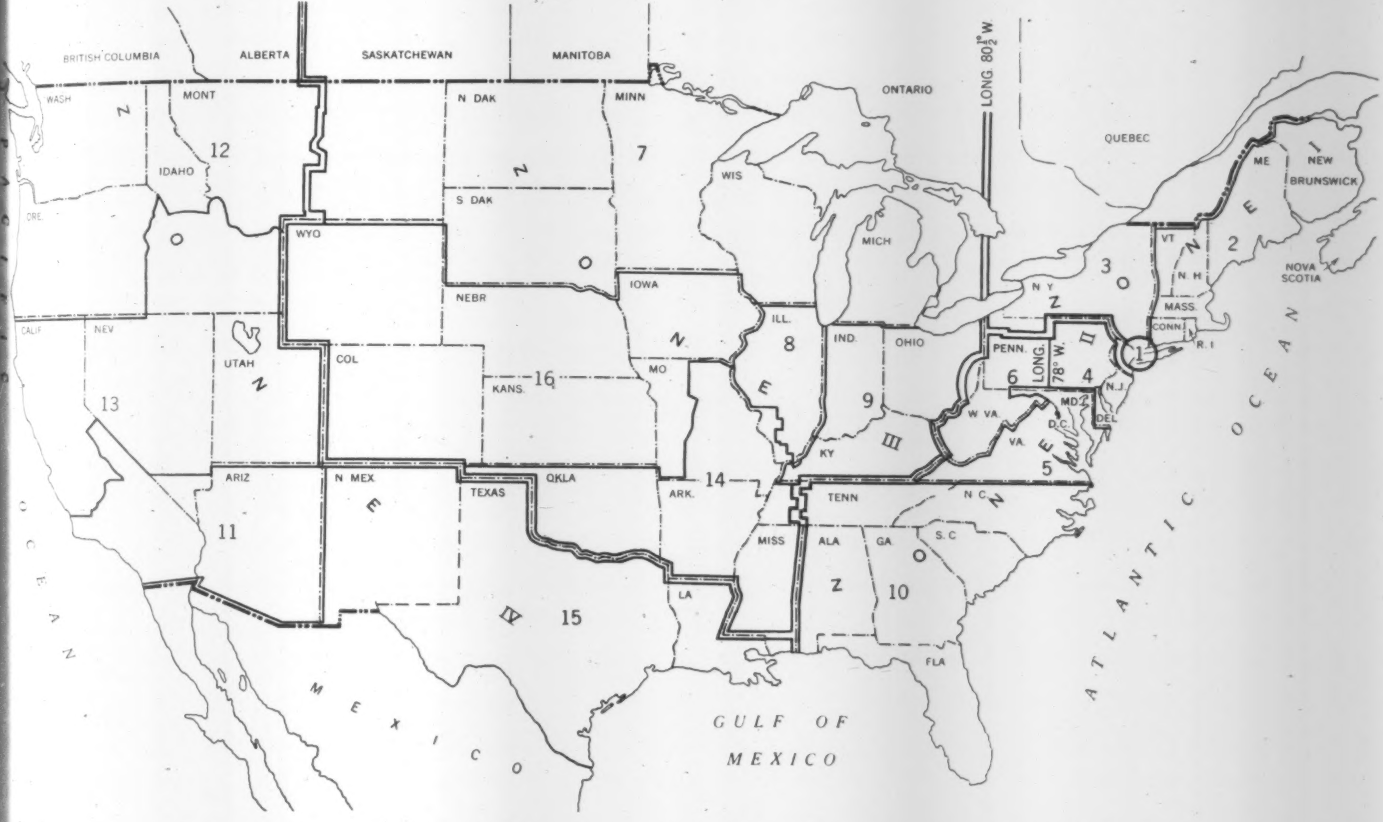
When the present Local Section boundaries were adopted in January 1938, it was realized that there were inconsistencies between these boundaries and those of the Districts and Zones. It was decided that these inconsistencies should be studied during the year 1938 for the purpose of reconciling them.

The boundaries of the Districts and Zones, as adopted in January 1931, were so located that in a number of instances they cut across the present Local Section areas, with the result that members residing in one part of a Local Section were represented by one Director and those residing in another part of the same Section were represented by another Director. Similarly, in several areas Zone boundaries also cut Local Sections in two so that members of the same Section were represented by two different Vice-Presidents.

To correct this situation, the Board of Direction of the Society, on January 16, 1939, approved certain changes in the boundaries of the Districts and Zones. The new boundaries will be described in detail, and also indicated on a map, in the new Year Book of the Society, to be mailed all members on April 15, 1939. For the use of members in the meantime, the map showing the revised Districts is reproduced herewith.

The principal requirements, as stated in the Constitution, are that each District shall be as nearly as practicable in one area; that there shall be an equality of representation in each District; and that Districts shall be formed with due regard to mutuality of interest and facility of travel between points within the District. After many studies, it has been found that there are inherent conflicts between the requirements of equality of representation, and mutuality of interest and facility of travel. The plan has given consideration to reconciling, as far as practicable, these requirements.

Except for District 1, which is represented on the Board of Direction by four Directors, each District is represented by one Director. There is one Vice-President for each Zone. This representation is the same as in the past.



District and Zone Boundaries Adopted by the Board of Direction on January 16, 1939

Three Local Sections Have Joint Meetings

Three Local Sections—Virginia, Mohawk-Hudson, and Kentucky—initiated the new year with joint meetings that proved highly successful.

The first of these—the annual joint meeting of the Virginia Section of the Society and local chapters of the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Institute of Architects, the Engineers Club of Hampton Roads, and the Central Virginia Engineers Club—took place on January 20 and 21. This two-day session, which was held at the John Marshall Hotel in Richmond, attracted a total registration of 350 engineers from all parts of the state.

The technical program, presented on Friday morning, consisted of papers by J. R. A. Hobson, Jr., director of public utilities for the city of Richmond, and L. E. Caldwell, educational director of the Electro-Motive Corporation. The latter discussed the design, manufacture, and operation of Diesel engines, while Mr. Hobson's subject was "Construction Problems of a High-Head Hydroelectric Plant." Both talks were illustrated by motion pictures. At noon there was a luncheon, at which the Honorable J. Fulmer Bright, mayor of Richmond, welcomed the group to the city. He was followed by Miles L. Colean, assistant administrator of the Federal Housing Administration, who discussed the prospects for residential construction.

The Virginia Section then held its business meeting, during which new officers were elected for the coming year. These are C. W. Johns, president; E. W. Saunders, first vice-president; G. M. Bowers, second vice-president; and E. S. Thomas, third vice-president. P. A. Rice continues as secretary-treasurer. Later in the afternoon there were talks by Dr. John C. Parker, president of the American Institute of Electrical Engineers, and H. H. Snelling, vice-president of the American Society of Mechanical Engineers. A social hour preceded the dinner, which was addressed by His Excellency, James H. Price, governor of Virginia. Col. Henry Welles Durham, who is on the staff of the New York World's Fair, then discussed the construction of that project, and dancing was enjoyed later. Wilson T. Howe, retiring president of the Virginia Section, was in charge of arrangements for the evening.

On Saturday morning the group visited the plant of the Richmond Engineering Company, where talks on welding methods were given and a motion picture on stainless steel was shown. Following a trip through the plant, where all stages in the fabrication of tanks were observed, a buffet luncheon was served to the members.

SEVERAL GROUPS PARTICIPATE IN MEETING OF MOHAWK-HUDSON SECTION

The Mohawk-Hudson Section held its joint session at Union College, Schenectady, N.Y., on January 26. On this occasion the participating groups were local chapters of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, the New York State Society of Professional Engineers, and the American Welding Society. A dinner preceded the meeting, which was attended by about 160.

Assuming the office of president of the Section for the coming year, Edward W. Wendell outlined his plans for the Section. In his talk Mr. Wendell emphasized the necessity of better contacts with the public and urged that more consideration be given the social and economic aspects of the profession.

The main speaker of the evening was Roy G. Finch, consulting engineer of Albany, who discussed the subject, "The Nicaragua Canal Versus the Panama Canal," illustrating his lecture with lantern slides. From 1929 to 1932 Mr. Finch served as a member of the Inter-Oceanic Canal Board to investigate and report on the proposed Nicaragua Canal project, and his remarks were received with great interest. In concluding his talk, he summarized the findings of the Canal Board, which advised that the building of such a canal would be entirely feasible from both an engineering and construction standpoint and that economy in shipping and benefits to trade would result.

KENTUCKY SECTION HAS FINE TECHNICAL SESSIONS

Two interesting technical programs were scheduled for a joint session of the Kentucky Section and the Kentucky Society of Professional Engineers, which was held in Louisville on January 27. The meeting began with a luncheon, which was attended by 59. A. H. Hinkle, president of the Section, was master of ceremonies. Following luncheon, the Honorable Joseph D. Scholtz, mayor of Louisville, addressed the afternoon session on the subject of home rule. The other speakers on that program were Jack Mage, of the U. S. Bureau of Public Roads ("State-Wide Highway Planning Survey"); Fred J. Hartstern, production manager for the Louisville Municipal Housing Commission ("Low Cost Housing"); Emmett Kirwan, traffic engineer for the city of Louisville ("Municipal Traffic Planning"); and A. A. Anderson, of the Portland Cement Association ("Building Safe Highways").

Following a dinner, there was an evening meeting with 89 in attendance. The program included addresses on a variety of subjects: "Development of Electrical Engineering During the Past Decade" (C. W. Frick, chief engineer of the General Electric Company); "Flood Control in the Ohio River Valley" (Captain Mitchell, of the Corps of Engineers, U. S. Army); and "Engineering Education and Research" (F. L. Wilkinson, Jr., dean of engineering, Speed Scientific School).

Tribute to Past-President Hill

IN RECOGNITION of the accomplishments of the late Louis C. Hill, Past-President of the Society, and of his services to the Board of Direction and to the Society over a long period of years, the Board authorized the preparation of a resolution expressive of its high regard. This resolution, as unanimously adopted by the Board, was in the following form:

WHEREAS the Board of Direction of the American Society of Civil Engineers has been grieved to learn of the death, on November 5, 1938, of its former President, Louis C. Hill; and

WHEREAS Mr. Hill had served his fellow citizens through a long and useful life, in his chosen profession; and

WHEREAS he was justly admired for his sterling character, his public service, and his distinguished professional activities; and

WHEREAS his counsel and guidance will be greatly missed among his fellow engineers, especially by the younger members of the profession with whom he came in contact, by his fellow members on the Board, and in all affairs designed to promote the welfare of the Society;

Now, therefore, be it resolved by this Board, assembled at its Annual Meeting at New York City, January 16, 1939, that it records its intense esteem for Mr. Hill, as a man and as a great engineer, and its profound sense of loss in his passing; that it extends its heartfelt sympathy to his family, and directs that this resolution be made a part of its official minutes, and that a copy hereof be forwarded to Mr. Hill's family.

Progress of Student Chapters During 1938

REVIEWING the year's work of the Society's Student Chapters, a full report of the Committee on Student Chapters was submitted to the Board at its January meeting. Among the various matters presented, the Committee recommended 12 of the Student Chapters in various parts of the country to receive special commendation, as noted in detail in the February issue. Other interesting features of the Committee's report are presented here.

At most of the universities and colleges in this country all student activities are under faculty and student scrutiny. Many student organizations are being called upon to justify their existence. Fortunately, the Student Chapters have no difficulty in so doing. Their activities supplement the academic program of the student and serve to develop his professional consciousness. The Chapter provides a forum for training the student in the preparation and presentation of papers, but unfortunately it is often difficult to secure student participation in Chapter meetings. The average for last year was about one student paper every other meeting. Many Chapters had no student papers. It is hoped that student participation can be increased. Invited speakers from outside presented one lecture or paper every third meeting. The remaining programs were filled by various forms of entertainment, inspection trips, faculty lectures, Society lectures with slides, addresses by officers of the Society, and so forth.

It is significant that the 110 Student Chapters reporting have a membership of 5,059, which represents 67 per cent of those eligible; and that 61 per cent of the membership attended the Chapter meetings. The average attendance for more than 1,300 meetings was 39.

During the past three years an average of 28 per cent of the graduating members of Student Chapters applied for Junior membership soon after graduation. In 25 Chapters the percentage was 45 or more. The Committee is strongly of the opinion that recruiting is not a proper function of the Student Chapters, but it is nevertheless a fact that an increasing number of the members of Student Chapters are applying for Junior membership upon graduation. It is not necessary to "sell" the Society to the student members—they take pride in it.

More than 50 joint meetings of Chapters and Local Sections were held during the year. The Committee believes that there is a definite obligation on the part of Local Sections to take an interest in and assist the Student Chapters in their respective areas. It is encouraging to note that this is being done to a greater extent each year. It is hoped that more joint meetings can be held. One way to strengthen the tie is to have the Local Sections send a group of members regularly to Chapter meetings. Another is for the Section to hold one of its meetings on the Chapter campus, perhaps asking the students to put on part of the Section program.

Authority has been given to Student Chapters, upon request, to designate Junior Contact Members as assistants to the regular or senior Contact Members where desired by the Chapter. The purpose of the request is to bring into contact with students one of the younger practicing members who is, so to speak, right on the firing line at the present time.

At Chapter meetings, students presented 48 per cent of the papers, faculty 12 per cent, and invited speakers 30 per cent. Ten per cent of the sessions featured the Society's lantern lectures. As to membership, the average Chapter is composed of 8 per cent freshmen, 17 per cent sophomores, 32 per cent juniors, and 37 per cent seniors, while 3 per cent are graduate students and another 3 per cent are undergraduates enrolled in evening sessions.

The Committee signing the report consisted of J. A. Anderson, Contact Member for the Board, E. M. Hastings, A. H. Holt, J. H. Porter, and R. B. Wiley, chairman.

Meeting of Incoming Board of Direction—Secretary's Abstract

The Board of Direction met at the Headquarters of the Society on January 19, 1939, with President D. H. Sawyer in the chair; and present George T. Seabury, Secretary; Past-Presidents Mead and Riggs; Vice-Presidents Pirnie, Ferebee, and Reppert; and Directors Agg, Anderson, Ayres, Bres, Brooks, Davis, Dean, DeBerard, Harrington, Hudson, Leeds, Legaré, Lewis, Needles, Root, Sawin, Shea, Stanton, Tiffany, and Treasurer Hovey.

Budget

The balanced budget for 1939, as approved and recommended by the Outgoing Board, was discussed and adopted with three minor changes.

Committees Appointed

On recommendation of the President, the following committee appointments were approved by the Board:

Executive Committee: D. H. Sawyer, *Chairman;* Malcolm Pirnie, *Vice-Chairman;* Henry E. Riggs, Daniel W. Mead, and E. N. Noyes.

Committee on Honorary Membership: D. H. Sawyer, *Chairman;* Daniel W. Mead, Henry E. Riggs, Malcolm Pirnie, E. N. Noyes, C. M. Reppert, and J. L. Ferebee.

Committee on Districts and Zones: R. P. Davis, *Chairman;* T. R. Agg, James A. Anderson, H. W. Hudson, and C. T. Leeds.

Committee on Professional Conduct: A. W. Dean, *Chairman;* R. P. Davis, W. W. DeBerard, Arthur W. Harrington, Thomas E. Stanton, Jr., and R. K. Tiffany.

Committee on Publications: E. R. Needles, *Chairman;* T. R. Agg, L. E. Ayres, A. W. Dean, and H. M. Lewis.

Committee on Membership Qualifications: William J. Shea, *Chairman;* R. B. Brooks, E. S. Bres, Arthur W. Harrington, J. E. Root, and Thomas E. Stanton, Jr.

Committee on Annual Meeting: Malcolm Pirnie, *Chairman;* H. M. Lewis, H. W. Hudson, E. R. Needles, and W. J. Shea.

Committee on Southern Meeting (Spring): C. M. Reppert, *Chairman;* James A. Anderson, R. P. Davis, S. W. Sawin, and T. Keith Legaré.

Committee on Annual Convention (Summer): E. N. Noyes, *Chairman;* E. S. Bres, C. T. Leeds, Thomas E. Stanton, Jr., and R. K. Tiffany.

Committee on Northern Meeting (Fall): Malcolm Pirnie, *Chairman;* A. W. Harrington, A. W. Dean, H. W. Hudson, W. J. Shea, E. R. Needles, and H. M. Lewis.

Committee on Technical Procedure:

Malcolm Pirnie, Board Member
J. L. Ferebee, Board Member
Harland Bartholomew, Chairman, City Planning Division
Daniel T. Webster, Chairman, Construction Division
F. H. McDonald, Chairman, Engineering Economics Division
L. G. Holleran, Chairman, Highway Division
F. C. Scobey, Chairman, Hydraulics Division
Augustus Griffin, Chairman, Irrigation Division
W. P. Creager, Chairman, Power Division
H. W. Streeter, Chairman, Sanitary Engineering Division
Carlton S. Proctor, Chairman, Soil Mechanics and Foundations Division
W. M. Wilson, Chairman, Structural Division
William Bowie, Chairman, Surveying and Mapping Division
W. G. Atwood, Chairman, Waterways Division
E. R. Needles, Chairman, Committee on Publications
George T. Seabury, Secretary

Committee on Professional Objectives: E. R. Needles, *Chairman;* Frederic W. Bass, Ivan C. Crawford, Henry L. Fruend, R. B. Brooks, A. M. Rawn, and W. W. DeBerard.

Committee on Local Sections: James W. Follin, *Chairman,* term ending January 1941; A. T. Dusenbury, term ending January 1940; J. T. L. McNew, term ending January 1942; W. M. Spann, term ending January 1943; and Thomas E. Stanton, Jr., *Contact Member.*

Committee on Juniors: N. T. Veatch, Jr., *Chairman,* term ending January 1940; S. B. Lilly, term ending January 1941; E. W. Bowden, term ending January 1942; A. C. Polk, term ending January 1943; and T. R. Agg, *Contact Member.*

Committee on Student Chapters: R. B. Wiley, *Chairman,* term ending January 1940; E. M. Hastings, term ending January 1943; A. H. Holt, term ending January 1941; John H. Porter, term ending January 1942; and R. P. Davis, *Contact Member.*

Committee on Engineering Education: Samuel B. Morris, *Chairman,* term ending January 1941; Leslie F. Van Hagan, term ending January 1940; T. C. Adams, term ending January 1942; L. S. LeTellier, term ending January 1943; J. A. Anderson, term January 1943; and A. W. Dean, *Contact Member.*

Committee on Fees: Frank A. Marston, *Chairman,* term ending January 1940; Walter L. Huber, term ending January 1941; Ernest E. Howard, term ending January 1942; L. R. Howson, term ending January 1943; and H. M. Lewis, *Contact Member.*

Committee on Public Information: William H. Adams, *Chairman,* term ending January 1940; Harry L. Kinsel, term ending January 1941; E. O. Sweetser, term ending January 1942; W. D. Binger, term ending January 1943; and S. W. Sawin, *Contact Member.*

Committee on Registration of Engineers: J. H. Dorroh, *Chairman,* term ending January 1941; Ralph J. Reed, term ending January 1940; W. C. E. Becker, term ending January 1942; L. M. Martin, term ending January 1943; and T. Keith Legaré, *Contact Member.*

Committee on Alfred Noble Prize: J. K. Finch, *Chairman.*

Committee on Freeman Fund: Thaddeus Merriman, *Chairman;* Malcolm Pirnie, and Walter E. Spear.

Committee Abolished

The Committee on Accredited Schools was abolished, its function having been largely obviated by the procedure of E.C.P.D. in accrediting civil engineering curricula and by the administrative function of the Committee on Student Chapters.

Routine Matters

Membership and other committee work were discussed. A number of problems involving regulation or continued procedure were also presented, with appropriate action.

Adjournment

The Board adjourned to meet at Chattanooga, Tenn., on April 17, 1939.

Procedure for Society Action Re National Policies

Recognizing that any proposed action of the Society or its constituent units involving policies of national import should have the benefit of study by the Board of Direction, much thought was given at the January 16 meeting of the Board to the proper handling of these matters. As an outcome of its deliberations, the Board perfected its procedure, which was unanimously adopted as expressed in the following resolution:

Whereas national policies involving principles upon which civil engineers are eminently qualified to advise are occasionally proposed and should be acted upon only after adequate study and deliberation; and

Whereas it will be helpful that engineering facts concerning such proposals be made available as soon as may be possible; and

Whereas approval by the Board of Direction is essential to any pronouncement affecting national policies:

Now, therefore, be it resolved that when a Technical or Functional Division proposes to formulate pronouncements or to report upon any matter affecting any national policy:

1. The report shall be submitted to the Board of Direction only through and with the approval of the Executive Committee of the Technical Procedure Committee.
2. The Board of Direction shall designate one of its members to sponsor such report when and if it is presented to the Board.
3. Only after receiving the approval and upon specific release by the Board of Direction shall such reports be given publicity.

American Engineering Council

The Washington Embassy for Engineers, the National Representative of a Large Number of National, State, and Local Engineering Societies Located in 40 States

As is customary in the opening of a new Congress, several hundred bills have already been introduced. Many of them will probably not get beyond committees in the present session of the federal legislature. However, among them the following group touch upon public problems in which American Engineering Council may be expected to be asked for factual information.

DEVELOPMENT OF NATURAL RESOURCES

S. 19—Mr. Hayden—To establish a National Resources Board.

Board to be composed of seven members, four to be appointed by the President with advice and consent of the Senate; compensation, $10,000 per year; term, four years. Other three members to be employees of Departments of War, Agriculture, and Interior, respectively, designated by secretaries of the respective departments for such service.

Board authorized (*a*) to conduct investigations, examinations, and studies, to analyze, assemble, coordinate, and from time to time review and revise basic information and materials appropriate to planning for conservation and development of the natural resources of the United States, and on basis thereof initiate and propose, in advisory capacity only, plans and planning policies; (*b*) in furtherance of these ends, to consult with any federal, state, or local governmental agency, or with any public or private planning or research organization; (*c*) prepare reports and recommendations upon matters within its jurisdiction upon request of either the President or the Congress.

The President to transmit to Congress annually plans proposed by Board for conservation and development of natural resources, navigation, flood control, reclamation, with his recommendation as to their desirability or necessity.

Authorizes formation of regional planning boards, subject to supervision and control of Board, each to consist of seven members, three to be selected by Board, one each from Departments of War, Interior, and Agriculture, and four to be residents of the area served by the regional board.

Transfers to the Board herein established records, property obligations and unexpended monies made available to National Resources Committee.

Referred to Committee on Public Lands and Surveys.

H. R. 2890—Mr. Bland—To create a Division of Water Pollution—control in the United States Public Health Service, and for other purposes.

Of several bills introduced in the current Congress to establish such a division, this is the most recent and is understood to be in the exact form of the legislation proposed in the last Congress which was vetoed by the President.

The legislation, to be cited as the Water Pollution Act, establishes a Division of Water Pollution Control in the U. S. Public Service, with a commissioned officer from the Service as director. The division is to prepare in cooperation with the Chief of Engineers of the War Department and state agencies, a comprehensive plan for prevention of pollution of navigable waters and tributaries, to encourage state pollution-control activities, uniform laws, interstate compacts, congressional consent being given for compacts for abatement of water pollution and establishment of joint agencies therefor. Authorizes an annual appropriation of $300,000 for maintenance of the Division, and $700,000 to be allotted to states for necessary investigations. Provides further for loans to states or persons for construction of sewage treatment works. A board of 5 commissioned engineers of the Public Health Service shall classify the navigable waters of the U.S. into sanitary districts.

Forecast for March "Proceedings"

POLLUTION OF BOSTON HARBOR

By Arthur D. Weston, M. Am. Soc. C.E., and Gail P. Edwards

An engineering analysis and recommendations for solving an acute sanitary emergency such as that facing all beach-bounded communities in varying degree.

DESIGN OF CIRCULAR CONCRETE TANKS

By George S. Salter, M. Am. Soc. C.E.

A logical mathematical design analysis of cylindrical tanks, accurate for tanks that are wide and shallow as well as for those that are tall and narrow.

Referred to the Committee on Rivers and Harbors.

It is interesting to note that the President's reason for vetoing the measure was not objection to the establishment of the Water Pollution Division but the fact that it had not been sent to the Bureau of the Budget for consideration.

Although this legislation was given very complete consideration during the last Congress, there are so many new members of the Rivers and Harbors Committee who are unfamiliar with the subject that it is probable hearings will be held for their benefit.

RIVERS AND HARBORS LEGISLATION

The Committee on Rivers and Harbors of the House of Representatives is engaged in the preparation of a general rivers and harbors bill. Projects included will be selected from those upon which a report has been received from the U. S. Board of Engineers. The committee has also had referred to it a considerable number of bills which favor the advancement of as many single projects, several of which will probably be included in the general bill.

GOVERNMENT REORGANIZATION

The House of Representatives has taken important action in forwarding reorganization of the federal agencies by adopting the Cochran Resolution (H. Res. 60), which authorizes the Select Committee of Government Organization to continue its work, grants the committee the same power, authority, and jurisdiction as that conferred upon it by the 75th Congress, and provides further, "that any bills or resolutions reported by the committee shall have a privileged status and it shall be in order to consider any such bills or resolutions so reported without the intervention of any point of order as provided in Clause IV or Rule XXI."

Speaker Bankhead has not indicated whether or not he will revamp the committee, other than to fill the vacancies which exist. Should he continue those members who served on the committee during the 75th Congress, the following would be reappointed: Representatives John J. Cochran (Dem.) of Missouri, chairman; Lindsay W. Warren (Dem.) of North Carolina, J. R. Robinson (Dem.) of Utah, Harry P. Beam (Dem.) of Illinois, John Tabor (Rep.) of New York, and Charles L. Gifford (Rep.) of Massachusetts.

Representative Warren plans to present to the committee within a few days a bill he is drafting in which he has sought to meet the objections to legislation defeated in the preceding congresses.

NATIONAL DEFENSE

S. 830—Mr. Walsh—To authorize the Secretary of the Navy to proceed with the construction of certain public works, and for other purposes.

H. R. 2880—Mr. Vinson of Georgia—Identical to above in title and content.

The 75th Congress "authorized and directed the Secretary of the Navy to appoint a board consisting of not less than five officers to investigate and report upon the need, for purposes of national defense, for the establishment of additional submarine, destroyer, mine, and naval air bases on the coasts of the United States, its territories and possessions." The above legislation was introduced to carry out in part the recommendations of that board which was headed by Admiral A. J. Hepburn.

In its report the Board recommended, as of immediate strategic importance, the increase of naval aviation facilities at several points in the mid-Pacific area; Kodiak and Sitka in the Alaskan area; and San Juan in the Atlantic area; also the increase of training facilities at Pensacola, Fla. All these items are included in the legislation proposed.

The bill authorizes the Secretary of the Navy to employ private architectural or engineering corporations, firms or individuals for the designs, plans, drawings, and specifications required for the naval public works or utilities projects or for the construction of any naval vessel or aircraft.

For Public Works projects authorized outside the United States by the act, the Secretary of the Navy is authorized to enter into contracts upon a cost plus a fixed fee basis with reputable, qualified contracting individuals, firms, or corporations.

Research

H. R. 1663—Mr. Lanham—To aid engineering and industrial research in connection with colleges and schools of engineering in the several state and territorial universities and colleges, and for other purposes.

Would establish in each state and territorial possession an engineering research bureau or station, to be under direction of one or more colleges or schools of engineering of graduate grade.

Secretary of Commerce to administer provisions of act; also to indicate from time to time such lines of inquiry as to him seem most important.

Authorizes to be appropriated to each state and territory, not to exceed $20,000 for fiscal year ending June 30, 1938, and similarly, not to exceed $30,000 for fiscal year ending June 30, 1939; $40,000 for fiscal year ending June 30, 1940; $50,000 for fiscal year ending June 30, 1941; $60,000 for fiscal year ending June 30, 1942; and $60,000 for each fiscal year thereafter.

Referred to Committee on Interstate and Foreign Commerce.

Incomes from Independent Professional Practice

The National Bureau of Economic Research has published a preliminary analysis of some of the results of a study of income from professional practice conducted over a period dating from 1929. The report is an intensive analysis of this data collected by the Department of Commerce in connection with its studies of national income.

Five professional groups are covered: physicians and surgeons, dentists, certified public accountants, lawyers, and consulting engineers. The first section of the bulletin presents the average levels of net income in the five professions for a series of years. The most striking fact in this analysis is that the average income of consulting engineers, approximately a third higher than that of the next highest group in the year 1929, drops sharply in three years to the lowest average income.

The average incomes of all the other four professions, while falling sharply, with the exception of the dental profession, do not reach as low an average. This drop is noted in the report as follows:

"The precipitous fall in the incomes of consulting engineers relative to those received in the other professions is not surprising. To a far greater extent than in the other professions the demand for the services of engineers comes from industries notoriously subject to violent cyclical fluctuations in activity—the construction and heavy industries in general. And consulting engineers are in an even more vulnerable cyclical position than engineers as a whole, since their services are required in larger part in connection with the initiation of new projects or the expansion of existing enterprises.

"The demand for the services of the other professions is much broader and is not concentrated in any one group of industries or final consumers. The broad pattern of change in their average net income resembles closely that in the average income from employment of all gainfully occupied persons."

Washington, D.C.
February 6, 1939

News of Local Sections

Scheduled Meetings

Arizona Section—Streets and Roads Conference at the University of Arizona on March 24 and 25, at 9:00 a.m.

Central Ohio Section—Luncheon meeting at the Chittenden Hotel on March 16, at 12 m.

Cleveland Section—Luncheon meeting at the Guildhall on March 7, at 12:15 p.m.

Colorado Section—Dinner meeting at the University Club, Denver, on March 13, at 6:30 p.m.

Dayton Section—Luncheon meeting at the Dayton Engineers Club on March 20, at 12:15 p.m.

Georgia Section—Regular monthly meeting at the Atlanta Athletic Club on March 13, at 12:30 p.m.; annual dinner dance on March 17.

Kansas State Section—Luncheon meeting at the Kansan Hotel, Topeka, on March 10, at 12:30 p.m.

Metropolitan Section—Technical meeting in the Engineering Societies Building, New York City, on March 15, at 8:00 p.m.

Oregon Section—Technical meeting at the University Club on March 17, at 8 p.m.

Sacramento Section—Regular luncheon meetings at the Elks Club every Tuesday at 12:10 p.m.

St. Louis Section—Luncheon meeting at the Mayfair Hotel on March 27, at 12:15 p.m.

Syracuse Section—Dinner meeting at the Onondaga Hotel on March 13, at 6:30 p.m.

Tennessee Valley Section—Dinner meeting of the Chattanooga Sub-Section at the Y. W. C. A. Cafeteria on March 21, at 6:30 p.m.

Utah Section—Dinner meeting at the Beau Brummel Café in Salt Lake City on March 3, at 6:30 p.m.

Wisconsin Section—Joint convention with Wisconsin Engineering Society in Milwaukee on March 15, 16, and 17.

Recent Activities

Alabama Section

A meeting of the Alabama Section was called to order in Birmingham on January 20, with 16 present. The principal speaker on this occasion was H. C. Boardman, research engineer for the Chicago Bridge and Iron Company, who gave an illustrated lecture on the engineering features of elevated tanks. E. E. Michaels, president of the Section, then reported the award of a certificate of life membership to H. K. Higgins, of Birmingham, explaining that poor health made it inadvisable for Mr. Higgins to attend a formal ceremony of presentation. During the annual business session the reports of the secretary and treasurer were read, and officers for 1939 were elected. These are J. H. Mayer, president; D. H. Barber, vice-president; and W. N. Woodbury, secretary-treasurer. W. H. Caruthers, chairman of the Committee on Civil Service, read a report on the activities of that committee, and D. H. Barber suggested the need for legislation regarding civil service for state employees. A motion was then made and carried that a legislative committee be appointed to work for needed legislation at the present session of the state legislature.

Buffalo Section

A luncheon meeting that took the form of a Christmas party was enjoyed by the members of the Buffalo Section on December 13. The presentation of certificates of life membership—to William Kelly and Edward P. Lupfer—initiated the program. Colonel Kelly then spoke, recalling his experiences as a young engineer in the Philippines, where his "main work was to keep one eye on the Moros and the other on a 75-mile road project." Mr. Lupfer also reminisced, giving an interesting account of his work on the construction of the Great Northern Railroad. He pointed out the fact that 90 per cent of the railroads in the country were built between 1860 and 1875. There were 54 present. At the luncheon meeting held on January 24 numerous business matters were discussed, and the report of the nominating committee was unanimously accepted. This resulted in the election of the following officers: Henry E. Riexinger, president; Nelson Stone, vice-president; Robert E. Davenport, secretary; and Wallace B. Carr, treasurer. The attendance numbered 22.

CENTRAL OHIO SECTION

There were 36 present at the regular monthly meeting of the Central Ohio Section, which took place in Columbus on January 19. Owing to the death of H. S. Jacoby, who was recently elected second vice-president of the Section, and to the removal of K. B. Woods, secretary-treasurer, from the Section, the election of several new officers was declared necessary. The revised list of 1939 officers for the Section is as follows: Paul M. Holmes, president; R. B. Jennings, first vice-president; C. V. Youngquist, second vice-president; and J. F. Barbee, secretary-treasurer. The floor was then given to Al Bass, guest speaker from the Ohio Farm Bureau, leading exponents of a state highway commission, who discussed the advantages of this type of highway administration. The opposition was presented by R. N. Waid, who defended the present type of administration—that of a highway director appointed by the governor. A talk on modern highways, given by the district engineer of the U. S. Bureau of Public Roads, concluded the meeting.

CINCINNATI SECTION

An interesting talk on foundation problems and their solution was the feature of the January 19 meeting of the Cincinnati Section. This was given by H. P. Burrell, chief engineer of the Western Foundation Company, who drew upon a wealth of experience in this country and Europe for the background of his talk. The meeting was followed by a buffet supper, provided by the Engineers Club. There were 80 present to enjoy this session, which was arranged by Robert Miller, of the program committee.

CLEVELAND SECTION

The February meeting of the Cleveland Section took place on the 7th. Accounts of the Annual Meeting of the Society were given by Prof. G. Brooks Earnest and R. A. Vanderhoof, while Prof. G. E. Barnes, chairman of the committee appointed to investigate the "field and scope of Section activity," reported on that subject. Then Frank C. Tolles, newly elected president of the Section, led an interesting discussion, in which the members expressed their views on such timely topics as the relationship between Juniors and Student Chapter members, meeting programs, and Section relationships with other organizations.

COLORADO SECTION

A number of committee reports were heard at the January meeting of the Colorado Section, which took place at the University Club in Denver on the 16th. After the discussion of numerous business matters, the meeting was turned over to R. L. Parshall, who introduced the guest speaker. This was N. A. Christensen, dean of Colorado State College, who gave an interesting illustrated talk on "Some Aspects of Flood Control in Southern California." An enthusiastic discussion from the floor followed. There were 42 at the dinner, with a number coming in later for the meeting. Several Juniors have been selected to help with the Section work during 1939. These include F. C. Hart, Junior representative to the president, and T. J. Noland, Jr., Junior assistant to the secretary.

DAYTON SECTION

To commemorate the formation of the Dayton Section in 1922, a special anniversary program was presented at the Engineers Club on January 16. Charles H. Paul, first president of the Section, was the master of ceremonies and principal speaker. In his talk Mr. Paul reviewed many of the events of the past sixteen years and described the making of several reels of motion pictures that were taken at the 1922 Spring Meeting of the Society, which was held in Dayton. The attendance numbered 22.

DISTRICT OF COLUMBIA SECTION

More than 160 members and guests of the District of Columbia Section gathered at the Willard Hotel in Washington on January 23 to honor Donald H. Sawyer, newly elected President of the Society, on his return from the Annual Meeting. The guests included Charles M. Reppert, Vice-President of the Society, Raymond A. Hill, former Director, and Secretary Seabury, as well as a number of heads of major agencies of the federal government. Colonel Sawyer was introduced by Mr. Seabury. The other speakers were Elmer F. Andrews, administrator of the wage and hour division of the U. S. Department of Labor, and Ernest L. Foss, director of the General Motors Preview of Progress. Mr. Andrews spoke on the effect of the fair labor standards act upon engineers, while Mr. Foss discussed the importance of scientific research in increasing employment by creating new industries.

FLORIDA SECTION

The Florida Section reports that at its annual meeting John R. Slade was elected president for 1939, and John F. Reynolds, secretary-treasurer. These elections were unanimous.

GEORGIA SECTION

A symposium on the subject of low-cost housing for Atlanta was the feature of the January 9 meeting of the Georgia Section. The principal address on this subject was given by Robert L. MacDougall, recently appointed technical director of the Atlanta Housing Authority. Mr. MacDougall had as his guests C. F. Palmer, president of the Atlanta Chamber of Commerce, and Harold D. Hynds, formerly chairman of the Central Housing Commission in Washington, D.C., who spoke briefly. During the business session a number of committee reports were presented. The attendance numbered 47.

HAWAII SECTION

Interesting geological features of the United States formed the subject of an illustrated lecture presented before the Hawaii Section at a dinner meeting held in Honolulu on December 20. The lecturer on this occasion was Harold S. Palmer, professor of geology at the University of Hawaii, who has recently completed a 20,000-mile motor trip in the United States. During the business session the report of the nominating committee was unanimously accepted, the results being as follows; Carl B. Andrews, president; V. B. Libbey, vice-president; and J. C. Marcroft, secretary-treasurer. It was also announced that Richard Quinn has become a life member of the Society. Later James H. Reid was appointed to fill Mr. Marcroft's unexpired term, as the latter is leaving Hawaii.

ILLINOIS SECTION

On February 9 the Illinois Section held a luncheon meeting in Chicago, which was attended by 23. On this occasion two talks were enjoyed. One of these was an account of the Annual Meeting in New York, which was given by W. W. DeBerard, Director of the Society; the other, a talk on the subject of Section activities, presented by Walter E. Jessup, Field Secretary of the Society.

INDIANA SECTION

The Indiana Section, at its dinner meeting in Indianapolis on January 16, was addressed by D. A. Davison, district engineer of the U. S. Engineer Office at Louisville, on the subject of "Flood Control on the Ohio River and Its Tributaries." Colonel Davison briefly sketched the development of transporation in this country, beginning with the first highways—the water courses. He stated that the Corps of Engineers has been connected with river and harbor work since 1802 and that there has been increasing federal participation in the cost of flood control work since that time. A spirited discussion of the flood control problem followed his talk. The list of 42 present included 12 guests.

ITHACA SECTION

There were 50 present at a joint meeting of the Ithaca Section and the Cornell University Student Chapter, which was held at the university on January 17. The principal speaker was Harold D. Hussey, designing engineer for the American Bridge Company, who discussed the construction of the Trylon and Perisphere at the New York World's Fair. This talk was illustrated with lantern slides, showing progressively the erection of the steel structures of both units. The usual dinner preceding the meeting was attended by 25. The Ithaca Section has passed a resolution supporting the proposed anti-billboard legislation now before the New York State Legislature.

KANSAS STATE SECTION

The Kansas State Section held its regular monthly meeting in Topeka on January 20. There were about 35 members and guests present on this occasion to hear C. E. Pearce, head of the department of machine design at Kansas State College, speak on the subject, "Automobile Riding Comfort." Professor Pearce discussed the contributions made by engineers in the construction of more confortable automobiles, basing his remarks on his recent studies in automotive design.

Louisiana Section

New officers for the Louisiana Section are A. J. Negrotto, president; N. E. Lant, first vice-president; J. A. McNiven, second vice-president; and V. J. Bedell, secretary-treasurer. These were elected at the annual meeting of the Section, which was held in New Orleans on January 18. The technical program presented at this time consisted of an address on the maintenance of the Huey P. Long Bridge over the Mississippi at New Orleans. This was given by Mr. Bedell, who is general manager of the Public Belt Railroad. The attendance numbered 50 members and several guests.

Metropolitan Section

The Mississippi River cut-offs was the subject of discussion at the January meeting of the Metropolitan Section, which was held in the Engineering Societies Building in New York on the 11th. The speaker scheduled to present this subject was H. B. Ferguson, president of the Mississippi River Commission, but illness prevented his appearance, and his paper was read by Gerard H. Matthes, principal engineer of the commission. The paper, which was extensively illustrated with lantern slides, elicited considerable discussion from the floor. Following the meeting there was a social hour, during which refreshments were served. The attendance was 350.

Michigan Section

A joint dinner meeting of the Michigan Section and the Student Chapter at the University of Michigan took place in Ann Arbor on January 25. Following dinner, President Rich turned the meeting over to Dr. Harry E. Miller, who introduced J. J. Bloomfield, his former colleague in the U. S. Public Health Service. Mr. Bloomfield gave an interesting talk on "Engineering Services in Industrial Hygiene," citing a number of actual cases of hazard reductions in industry. The 49 members and guests present remained at the close of the technical program to enjoy a social hour. Additional members of the Michigan Section to receive certificates of life membership are Clarence T. Johnston, Edward D. Rich, and Ira O. Thorley.

New Mexico Section

Election of new officers was the main order of business at the December 19th meeting of the New Mexico Section. The list of these is as follows: Thomas M. McClure, president; Herbert W. Yeo, first vice-president; Burton Dwyre, second vice-president; and William Alan Laflin, secretary-treasurer. The treasurer's report was presented at this session, and several committees were appointed. A dinner preceded the meeting.

North Carolina Section

The North Carolina Section held its first technical meeting of the year in Raleigh on January 28. There were 46 present to enjoy the fine program that had been arranged. Those appearing on this program were Dudley Bagley, who presented a paper on "Rural Electrification in North Carolina"; Thomas E. Winn, state field engineer for the WPA, who discussed the Works Progress Administration in North Carolina; and W. C. Olsen, consulting engineer of Raleigh, whose subject was "Rejuvenation of the Raleigh Water Works." There was also a business session and a meeting of the board of direction of the Section.

Northeastern Section

On January 27 the annual meeting of the Northeastern Section took place in Boston, with about 70 members and guests present. The speakers and guests of honor were Donald H. Sawyer, President of the Society; C. Frank Allen, newly elected Honorary Member of the Society; and Secretary Seabury. Colonel Sawyer discussed the engineer's place in the present scheme of things, and Mr. Seabury reported on the work of the Society in economic situations facing the profession and outlined the rôle of the Local Sections in this work. Professor Allen related some of his interesting experiences in the Society. The officers for 1939 are Samuel M. Ellsworth, president; C. W. Banks, vice-president; and Francis H. Kingsbury, secretary-treasurer.

Northwestern Section

The February dinner meeting of the Northwestern Section was held at the University of Minnesota on the 6th. A number of announcements were made, and several committees appointed during the business session. Then President Loeffler introduced Samuel C. Lind, dean of the Institute of Technology of the University of Minnesota, who gave an interesting talk on the organization and operation of the institute. The attendance numbered 22.

Oregon Section

About 50 members and guests of the Oregon Section attended the February meeting of the Section, which was held in Portland on the 2d. Following the customary business session, C. A. Hogentogler spoke on "Recent Developments in Soil Mechanics." Mr. Hogentogler is highway engineer in the Division of Tests and Research of the U. S. Bureau of Public Roads, Washington, D.C. The program concluded with a general discussion of Mr. Hogentogler's talk, which was led by E. A. Willis.

Philadelphia Section

Members of the Philadelphia Section enjoyed an unusual program for their December meeting, the topic of discussion being "What Your Local Section Means to You." The first speaker in the symposium was B. F. Hastings, who explained the function of engineering societies in general and the rôle of the Local Section in "localizing" these functions. Charles H. Stevens then related the history of the Section's permanent fund. Prof. Scott B. Lilly next discussed the development and growth of Student Chapters, and Francis Friel spoke on the functions of the Local Membership Committee. The concluding speaker was Field Secretary Jessup, who showed the relation of the Local Section to the Society. A special feature of the meeting was the presentation of certificates of life membership in the Society to nine members of the Section. Secretary Seabury, who was also present, presided at this ceremony. There were 65 at the meeting, and 55 at the dinner preceding it. On January 23 the Section held a joint meeting with the Philadelphia Chapter of the Pennsylvania Society of Professional Engineers. The speakers appearing on this program were Harry S. Ford, president of the National Society of Professional Engineers; Robert H. Craig, editor of "The American Engineer"; Frederick H. Dechant, consulting engineer of Reading, Pa.; C. E. Myers, president of the State Registration Board for Professional Engineers of Pennsylvania; and Willard S. Conlon, executive secretary of the National Society of Professional Engineers. Others who spoke were Samuel I. Sacks, chairman of the meeting, Harry S. Stanton, and representatives of the Philadelphia Chapter of the American Institute of Architects. There were 75 at the meeting and 50 at the dinner preceding it.

Rochester Section

The Rochester Section reports that its officers for 1939 are as follows: Carey H. Brown, president; Norman H. Davidson, first vice-president; Arthur L. Vedder, second vice-president; and Albert R. Reilly, secretary-treasurer.

Sacramento Section

Interesting programs were arranged for the regular weekly luncheon meetings of the Sacramento Section in January. On the 3d the speaker was Clifford H. Wahl, manager of the Perkins Sand and Gravel Plant, who gave an illustrated lecture on his four years of construction experience in Central and South America. The annual business meeting with election of officers was held on the 10th, with the following results: Frederick W. Panhorst, president; Oswald Speir, first vice-president; Edwin A. Fairbairn, second vice-president; and Theodore Neuman, secretary. On the evening of the 10th, the Section's annual dinner and dance attracted an attendance of 233. The Standard Oil Company showed two motion pictures at the regular meeting on the 17th. There was the large attendance of 121 at the luncheon on January 24, when C. A. Hogentogler addressed the Section on the subject, "Rôle of the Laboratory in Engineering Practice." On the 31st, I. C. Steele, chief of the division of civil engineering of the Pacific Gas and Electric Company, spoke on the company's construction activities.

St. Louis Section

The 255th meeting of the St. Louis Section took the form of a luncheon on January 23, which was attended by 54. E. E. Wall was present and received the hearty congratulations of the Section on his recent election to honorary membership in the Society. At the close of a brief business session Charles F. MacNish delivered a paper on "Welding Consciousness," which was a summary of a paper for which he and Howard E. Boath won a major award in the James F. Lincoln Arc Welding Foundation Contest. The talk was illustrated by a series of excellent slides, which pictured the various details of both welded and riveted Tainter gate assemblies.

SAN DIEGO SECTION

There were 12 present at the annual meeting of the San Diego Section, which took place on December 22. The annual election of officers held at this time resulted as follows: Paul Beermann, president; C. B. Sadler, vice-president; and C. W. Capwell, secretary-treasurer. At the meeting held on January 26 there was an attendance of 16 to hear Rush T. Sill, consulting engineering geologist of Los Angeles. Mr. Sill discussed the history and romance of mining and, also, presented some comparative data on the production of minerals in the United States and the rest of the world.

SAN FRANCISCO SECTION

On January 17 members of the Junior Forum of the San Francisco Section gathered for their regular monthly meeting. Several Section officers, including President Fowler, were present and spoke briefly, expressing their interest in the aims and activities of the Junior Forum and their willingness to cooperate. The meeting was well attended, and the topic for discussion, "Should the United States Compete with Foreign Nations in Rearmament," brought forth many interesting comments. The discussion was led by John Edward Cahill and George Nelson Newhall. An instructive paper on "Water Treatment Experiments at Boulder City," presented by Robert C. Kennedy, concluded the program. Arrangements for the evening were made by Dudley F. Stevens.

SEATTLE SECTION

The Seattle Section held its annual dinner meeting on January 16, at which it honored lady guests and the newly elected life members of the Society—Ernest R. Gayler, Herman F. Tucker, and Herbert J. Wild. The total attendance was 57. Following dinner, the speakers on the technical program were introduced. These were Bertram H. Lindman, engineer economist for the Highway Transportation Commission, who discussed the economics of transportation, and Carl Fritts, traffic engineer of the Washington State Highway Department. The latter spoke on traffic control and safety features of Washington highways. The Section held its regular monthly meeting on January 30, with 22 present. During the business session it was voted to donate the sum of $25 to a fund, to which other Sections in the Northwest have also contributed, to help defray the traveling expenses of engineering students to the forthcoming Northwest Student Conference. The election of officers held at this time resulted as follows: Roy M. Harris, president; C. M. Howard, vice-president; and Fred H. Rhodes, Jr., secretary-treasurer.

SOUTH CAROLINA SECTION

A joint meeting of the South Carolina Section and the South Carolina Society of Engineers took place in Columbia on January 6. The guests of honor included President Riggs and Vice-President Bellinger. Dr. Riggs spoke, and there were also three technical addresses. These were given by Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads; F. A. Dale, chief engineer of the Harza Engineering Company; and Ben M. Sawyer, chief highway commissioner for the South Carolina State Highway Department. During the business meeting the following officers were elected: F. R. Sweeny, president; E. R. Cary, vice-president; and Albert E. Johnson, secretary-treasurer. The two latter will serve two-year terms. It was also voted to award annual prizes to the amount of $60, to be given each year at the South Carolina meeting of the Carolina Student Chapter Conference.

SPOKANE SECTION

The January meeting of the Spokane Section, held at the Davenport Hotel on the 13th, was devoted entirely to business discussion and to making plans for the coming year. It was decided to resume the regular monthly luncheons to supplement the evening technical sessions. There were seven present.

TENNESSEE VALLEY SECTION

Nearly 100 members and guests of the Knoxville Sub-Section of the Tennessee Valley Section were present at the January meeting to hear Erwin C. Harsch, bridge engineer for the Tennessee Valley Authority, give an illustrated talk on the raising of the bridge over the Tennessee River at Guntersville, Ala. The meeting concluded with community singing, led by R. L. Forshay. At the meeting held on February 7, a symposium on "Chattanooga Flood Control Problems" was presented. Joseph H. Kimball, principal hydraulic engineer for the Tennessee Valley Authority, gave the principal address on this program, while Carl A. Bock, chief consulting engineer for the Tennessee Valley Authority, led the discussion. Additional discussions were presented by J. S. Bowman, C. W. Okey, and E. C. Foust, all of the staff of the Tennessee Valley Authority. The attendance of 140 included several members of the University of Tennessee Student Chapter.

WYOMING SECTION

The annual meeting of the Wyoming Section took place in Cheyenne on January 12. A banquet, attended by 44, preceded the meeting. The list of those present included eight well known Wyoming engineers, who were guests of the Section, as well as two officers from the Colorado Section. R. D. Goodrich, retiring president of the Section, gave the annual address, reviewing the activities and accomplishments of the Section during the past year. The response was made by H. T. Person, newly elected president, who outlined his tentative program for 1939. The other officers for the coming year are John D. Quinn, vice-president; A. J. McGaw, secretary-treasurer; Tolliff R. Hance, assistant to the president; and Walter W. Flora, assistant to the secretary. Professor Person also gave a paper entitled "Registration of Engineers in Wyoming," which was followed by an active discussion of licensing professional engineers and of state registration laws. Numerous business matters were also discussed.

Student Chapter Notes

BUCKNELL UNIVERSITY

The Bucknell University Student Chapter reports that a meeting was enjoyed on January 12, informal talks by students making up the program on this occasion. New officers for the remainder of the year were also elected at this time. They are Donald Drumm, president, and Charles Millard, secretary-treasurer.

KANSAS STATE COLLEGE

At a meeting of the Kansas State College Student Chapter held on January 19 the following officers were elected for the spring semester: Harold E. Brown, president; George W. Vaught, vice-president; Garrett Gardner, secretary; and C. Alanson Foreman, treasurer. Following the election, there was a talk by R. J. Paulette, secretary of the Kansas Registration Board for Professional Engineers, who explained the purposes of compulsory registration for professional engineers. Then Prof. L. E. Conrad discussed the advisability and advantages of Student Chapter members' applying for Junior membership in the Society as soon after graduation as possible.

STANFORD UNIVERSITY

The Stanford University Student Chapter, one of the oldest in the country, entertained the fledgling University of Santa Clara Student Chapter on January 25. The feature of the occasion was a talk on "Law and Life" given by Prof. H. J. Rathbun, of the Stanford Law School. The hosts for the evening were Professors Earl C. Thomas, J. B. Wells, John Hedberg, and D. H. Young.

UNIVERSITY OF ARIZONA

There were 47 members and guests of the University of Arizona Student Chapter present at a meeting held on January 4. Tom R. Johnson, associate engineer for the U. S. Bureau of Reclamation on the construction of Bartlett Dam, was the speaker on this occasion, the subject of his talk being "Preliminary Surveys of the Bartlett Dam Site." Mr. Johnson is an alumnus of the University of Arizona and a former Student Chapter member. The concluding feature of the program was a talk on "Ingenuity in Engineering," which was presented by Tom Wilson, senior-class civil engineering student.

ITEMS OF INTEREST

Engineering Events in Brief

CIVIL ENGINEERING for April

CONTINUING the series of articles on modern construction tools and methods, J. L. Burkholder and Richard Stevens have prepared for the April issue of CIVIL ENGINEERING a comprehensive paper on "Hard Rock Tunneling." Experience with ninety-two miles of Colorado River Aqueduct tunnels, built in less than six years under one management, provides the authors with an unusual opportunity, of which they have taken full advantage, to form conclusions as to the relative economy of comparable methods. "Many experienced tunnel men," they write, "hold the opinion that tunnels may be driven either for progress or for economy, but that maximum economy with maximum progress cannot be attained. Experience on the Colorado River Aqueduct refutes this common belief. With the present greater use of mechanical units, high progress normally reflects high economy. Less labor and more equipment is being used underground and this combination is especially effective in reducing excavation costs."

DRILLING THE LAST HEADING AT LAWRENCE ADIT, COLORADO RIVER AQUEDUCT

Also on the schedule for April is an article by Howard F. Peckworth on "Field Control of Compacted Earth Fill." The extensive use of earth fills, says the author, depends in part on the degree of control of the material and the compaction procedure that can be exercised by the engineer in charge and by the contractor doing the work. Accordingly, he presents "a simple and reasonably accurate method of finding the degree of densification of compacted earth" and "a field method giving directly the relationship between the density of a given material of known moisture content and the number of passes with a given roller."

Discussion of the professional, social, and economic status of the civil engineer, begun in the current issue, will be continued in April with a group of short papers that were originally presented as discussions of the "Professional Status" symposium at the Annual Meeting. The first of two papers by F. H. Frankland on the manufacture of iron and steel, unavoidably deferred from the current issue, will also appear. And of special interest to sanitary engineers will be Leslie C. Frank's article describing their problems and duties in the comparatively new field of milk sanitation.

Papers on city planning and hydrology, and an article of historical interest, will round out the issue.

New Technical Public Works Committee to Expedite Federal and Local Planning

IN ORDER to bring together federal officials concerned with public works and citizens especially qualified to advise on the economics and timing of public construction activities, the National Resources Committee recently announced the appointment of a Technical Public Works Committee. Colonel Henry M. Waite, M. Am. Soc. C.E., was named chairman, and Francis W. Herring, Assoc. M. Am. Soc. C.E., of the American Public Works Association, vice-chairman. Other members are F. E. Schmitt, M. Am. Soc. C.E., *Engineering-News Record;* Otto T. Mallery, member Pennsylvania State Planning Board; William Stanley Parker, Construction League of America; Frederick J. Lawton, Bureau of the Budget; Corrington Gill, Works Progress Administration; Fred Schnepfe, Assoc. M. Am. Soc. C.E., Public Works Administration; Lowell Chawner, Department of Commerce; A. F. Hinrichs, Department of Labor; and Lt. Col. Paul W. Baade, War Department.

This group has been asked to assist the National Resources Committee in continuing its preparation of six-year programs of federal public works and in stimulating the preparation of such capital budget programs by states and cities. In addition, the new committee will undertake studies to determine the most effective utilization of state and local public works for stabilizing the construction industry, and to analyze the plan of public construction activities in providing employment and increasing the national income. This work is intended to expedite the preparation of such programs by the National Resources Committee and to increase local and state activities in this direction.

Mulholland's Memory

By J. B. LIPPINCOTT, HON. M. AM. SOC. C.E.

CONSULTING HYDRAULIC ENGINEER, LOS ANGELES, CALIF.

Under the chairmanship of J. B. Lippincott, Hon. M. Am. Soc. C.E., a special committee authorized by the directors of the Los Angeles Section is engaged in collecting memoirs of the famous William Mulholland—builder of the Los Angeles Aqueduct and initiator of the studies that culminated in construction of the Colorado River Aqueduct. Among the stories that have already come to light is the following.

WHEN the franchise of the Los Angeles City Water Company expired in 1898, a valuation of the property became necessary to determine the price to be paid for it by the city. The city employed a board of engineers, which included the writer, to present its case to the arbiters, and this board called upon Mr. Mulholland, manager and engineer of the company, for information.

As is frequently the case with people of fine memory, Mr. Mulholland's records were not perfect. After the Board of Engineers, as politely as it could, had expressed an opinion that these records were not sufficient for a proper valuation of the property, Mr. Mulholland asked, "Well, what is it you want?"

Said one of the board: "The thing we want is a complete list showing the length of pipe, its size, character, and its age. We also want to know the number of gate valves and all about them, as well as fire hydrants and other structures connected with the water system."

Upon hearing this sweeping request, Mr. Mulholland spread out on a drafting table a map of the city and gave from memory the size, kind, and age of the pipe in every one of the city streets in which it was laid. He also designated the gate valves and hydrants. The board expressed surprise in his memory but stated it did not feel that an inventory made in this way was adequate. Consequently we indicated, with red circles on the map, 200 places throughout the city where we wished to have the pipe exposed to view.

Mr. Mulholland was not disturbed in the least over this request. In fact, he seemed rather pleased. He had the pipe dug up in the 200 places indicated; the Board of Engineers actually inspected and classified the condition of all the pipe exposed; and the inspection indicated that Mr. Mulholland's memory was correct in every particular. We thereupon accepted the complete inventory which he had prepared from memory.

When the city finally acquired the water company's properties in 1902, at a cost of $2,000,000, Mr. Mulholland was retained as manager of the system.

Engineers Represented on Civil Service Committee

PRESIDENT Roosevelt has appointed a committee, under the chairmanship of Justice Stanley Reed of the Supreme Court, to study, among other things, the relation of civil service to legal and technical positions. Engineers are represented on the committee by Gano Dunn, M. Am. Soc. C.E.

The statement issued at the White House explains that the committee will study the diverse problems presented in the recruiting and promotion of the professsional, administrative, and other technical personnel for the various government departments and agencies. "The President believes," it continues, "that such a study will result in an informed and wise extension of the merit system and the application of higher standards in the selection and promotion of such government personnel."

Timber Bridge Design Contest Announced

PRIZES totaling $1,500 are being offered by the National Lumber Manufacturers Association and its subsidiaries for the best designs for a highway bridge to be constructed of timber and employing the timber connector method of construction. First of the major prizes is $500. In a separate classification, open only to students, the first prize is $200. The closing date for submission of entries is August 15, 1939.

Contest rules provide that the span chosen may be 30, 40, 50, 60, or 70 ft; that the live load may be H-10 or H-15; and that the roadway shall be 18 ft in the clear. Complete details are contained in a pamphlet that will be supplied on application to the Contest Secretary, Timber Bridge Design Contest, 1337 Connecticut Avenue, N.W., Washington, D.C.

A.S.A. Activities in 1938

EDMUND A. PRENTIS, representative of the Society on the board of directors of the American Standards Association, has submitted the following report of the work of that organization during 1938:

"During 1938 thirty-six American Standards were approved, making a total to date of 401. The increase in usefulness of the Association is apparent from the increasing number of opportunities for service offered it from year to year by industry and by others, the most recent outstanding example of this being the request by industry to maintain an agent in Buenos Aires to promulgate the use of American Standards in South America, particularly in the Argentine. In this instance, of course, the work would be financed by those companies having special interests there.

"The general work of the Association is handicapped somewhat by the fact that it is understaffed. This can only be remedied by more adequate financial support, a thing difficult to achieve at present. It operates, however, on a substantially balanced budget of about $109,000."

At the annual meeting of the Association last December, Mr. Prentis was elected president for the year 1939.

Brief Notes from Here and There

"TEMPERATURE and Its Measurement in Science and Industry" is the topic of a symposium being planned for next fall by the American Institute of Physics. "Men in construction work who have to worry about temperature will be called upon to contribute," states Henry A. Barton, director, "and we are depending as much on engineers and chemists as we are on physicists to make the symposium valuable. Those interested in taking part should communicate with the Institute at 175 Fifth Avenue, New York, N.Y.

* * * *

FROM Texas, John A. Focht, M. Am. Soc. C.E., contributes the accompanying photo, with the comment, "This indicates the *n*'th variety of engineers in the United States." The "for rent" signs suggest that the number of varieties may now have been reduced to $n - 1$.

TIRE ENGINEERS

NEWS OF ENGINEERS

Personal Items About Society Members

HARRY W. DENNIS, formerly Director and Vice-President of the Society, who is about to retire as chief civil engineer of the Southern California Edison Company after thirty years with that company, has been appointed to fill an unexpired term on the Los Angeles Board of Public Works. In the present reorganization, the only member of the former board whom it is proposed to retain is CARL WIRSCHING, also an engineer and a member of the Society.

WILLIAM A. HADLEY assumed the post of city engineer of Gainesville, Fla., on January 1. Previously he served as resident engineer for the State Highway Board of Georgia, where he supervised the construction of several bridge and road projects.

SAMUEL W. BOWERS, engineer and surveyor of Southington, Conn., has been made superintendent of the Southington water works department.

EDWIN K. MORSE, consulting engineer of Pittsburgh, Pa., has been unanimously elected to honorary membership in the Pittsburgh Chamber of Commerce in recognition of his services to the community in the promotion of flood control and in numerous other public matters. Only twice before in its long history has the Chamber of Commerce conferred honorary memberships.

EDWIN K. MORSE

FRANK L. RASCHIG, formerly an engineer for the asphalt sales department of the Standard Oil Company, has been appointed division engineer at Middletown (Ohio) for the Ohio State Highway Department.

HARRY N. JENKS has moved his consulting practice from Berkeley, Calif., to Palo Alto.

BARTON M. JONES, who for the past year and a half has been acting chief designing engineer for the Tennessee Valley Authority, was recently appointed consulting design engineer. He is succeeded by HARRY A. HAGEMAN, chief hydraulic engineer.

J. M. R. FAIRBAIRN has retired as chief engineer of the Canadian Pacific Railway. He became connected with this railroad in 1901 and in 1921, after several promotions, was made chief engineer.

J. W. ACKERMAN, since 1932 chief engineer and general superintendent of the Consolidated Water Company, of Utica, N. Y., has been retained as chief engineer by the City of Utica. The city recently bought the water system from the company.

ARTHUR MONTZHEIMER has resigned the post of chief engineer of the Elgin, Joliet and Eastern Railway after serving in that capacity since 1903.

FREDERICK T. MAVIS will become head of the department of civil engineering at Pennsylvania State College on June 30, following the retirement of ELTON D. WALKER. Professor Mavis is now head of the department of mechanics and hydraulics at the State University of Iowa.

M. R. TILLOTSON, who is with the U. S. Department of the Interior, has been transferred from the position of superintendent of the Grand Canyon National Park to that of regional director of Region I of the National Park Service, with headquarters at Richmond, Va.

W. L. Stevenson was recently appointed director of the Bureau of Engineering in the Pennsylvania Department of Health at Harrisburg, Pa. He was formerly in charge of Metcalf and Eddy's Harrisburg office.

Schuyler B. Knox, for many years associated with the Fort Pitt Bridge Works in various capacities, has resigned as manager of that company's New York office.

Harvey W. Sarven, previously assistant to the plant manager of the New Jersey Realty Title Insurance Company, is now draftsman for the Pennsylvania Turnpike Commission. He is located at Harrisburg, Pa.

Chester M. Everett, civil engineer, announces that he has closed his office in New York City and hereafter will be available for consultation by special appointment through Malcolm Pirnie. Mr. Pirnie has acquired all of Mr. Everett's records, plans, and specifications for use in his engineering practice.

John C. Beebe is now chief of the Division of Power-Flood Control Surveys of the Federal Power Commission, with headquarters in Washington, D.C. He was formerly assistant regional forester for the U. S. Forest Service at San Francisco, Calif.

Gilberto M. Font, until lately superintendent of construction for Salvador Quinones at Aguadilla, Puerto Rico, has accepted the position of secretary and executive director of the Housing Authority of the Capital of Puerto Rico. He is located at San Juan.

Constantin C. Nizenkoff has joined the staff of the Boeing Aircraft Company at Seattle, Wash., in the capacity of draftsman.

Samuel John Rowland is now a junior naval architect for the U. S. Navy at the Puget Sound Navy Yard, Bremerton, Wash.

DECEASED

Charles Leland Batchelder (M. '36) district engineer for the U. S. Geological Survey at St. Paul, Minn., died on January 18, 1939, at the age of 52. Mr. Batchelder was junior and, later, assistant engineer for the U. S. Geological Survey from 1912 to 1918, and from 1918 to 1928 he was section manager of the Warmsprings Irrigation District at Vale, Ore. In 1928 he became district engineer for the U. S. Geological Survey at St. Paul.

James Edward Carroll (M. '16) consulting engineer (the Carroll Engineering Company), of St. Paul, Minn., died at the U. S. Veterans' Hospital in Minneapolis on January 25, 1939. He was 67. From 1893 to 1903 Mr. Carroll was in the Engineers' Department of the City of Minneapolis, and from 1903 to 1912 city engineer of Crookston, Minn. Before establishing his consulting practice he was for a number of years superintendent of construction and repair for the City of St. Paul.

Frank E. Winsor

Frank Edward Winsor (M. '05) chief engineer of the Metropolitan District Water Supply Commission, Commonwealth of Massachusetts, died suddenly on January 30, 1939, at the age of 68. During his career Mr. Winsor had charge of building the Charles River Dam basin in Boston, the Kensico and Hillview reservoirs near New York City, and a large water system for the city of Providence, R.I. For the past thirteen years he had charge of the Quabbin Reservoir Project and in 1936 was appointed chief engineer of the Metropolitan District Water Supply Commission. Long active in the affairs of the Society, Mr. Winsor served as Director from 1922 to 1924 and as Vice-President in 1930 and 1931. At various times he was on the Executive Committee of the Board, and he represented the Society on the Engineering Foundation, Engineers Council for Professional Development, and various other engineering organizations.

Ernest Bertrand Hussey (M. '08) consulting civil engineer of Seattle, Wash., died in that city on December 27, 1938, at the age of 73. A native of New England, Mr. Hussey moved to Seattle in 1889, establishing his practice there in the same year. He served as engineer on the construction of the Walla Walla (Wash.) water works and made many land surveys throughout the state of Washington. From 1930 on he was chairman of the Seattle Terminal Board.

Jenks Buffum Jenkins (M. '16) since 1914 valuation engineer for the Baltimore and Ohio System, died suddenly at his home in Baltimore, Md., on February 1, 1939. He was 70. Colonel Jenkins was with the Baltimore and Ohio from 1889 on with the exception of seven years (1893 to 1900) spent in private practice and in the service of the New York City Board of Public Improvements. During the war he was furloughed for military duty, being commissioned a major and, later, a colonel in the Engineers' Reserve Corps of the Army. Colonel Jenkins originated and developed the Ten-Chord Spiral, which was adopted by the American Railway Engineering Association.

Lucien Samuel Johnson (M. '01) of Louisa, Ky., died in a hospital in Cleveland, Ohio, on December 10, 1938. Mr. Johnson, who was 76, went to Louisa as a civil engineer in the eighties. In 1896 he entered the Corps of Engineers, U. S. Army, and spent a number of years building coastal defenses in New England. In 1910 he was assigned as engineer in charge of constructing Dam No. 13 in the Kentucky River and two years later was made engineer in charge of the Kentucky River, a position he held until his retirement six years ago.

Henry Read Leonard (M. '94) died at his home in Wayne, Pa., on January 11, 1939, at the age of 81. Mr. Leonard's early career included nine years in the office of the city engineer of Boston and several years as engineer for the Philadelphia Bridge Works. In 1902 he joined the staff of the Pennsylvania Railroad as engineer of bridges. Later he was made chief engineer of bridges and buildings, remaining in this position until his retirement in 1928. Mr. Leonard served as Director of the Society from 1913 to 1915.

Frederick Mears (M. '14) assistant chief engineer for the Great Northern Railway, died in Seattle, Wash., on January 11, 1939, at the age of 50. From 1906 to 1914 Mr. Mears served with the Isthmian Canal Commission in Panama, and from 1914 to 1917 was a member of the Alaskan Engineering Commission engaged in railroad construction in Alaska. During the war he served in France as colonel of engineers, later returning to his Alaska post. In 1925 Mr. Mears was appointed to the position he held at the time of his death.

Edwin Jay Nichols (M. '96) of Tyler, Tex., died on December 11, 1938, at the age of 80. Mr. Nichols began his long career in railroad work in 1886. He was connected with several lines in the West and in 1912 became locating engineer for the St. Louis Southwestern Railway Company Lines. He remained in this position until his retirement about two years ago.

Frank Henry Olmsted (M. '00) of Glendale, Calif., died there on January 5, 1939, at the age of 80. During Mr. Olmsted's long career he laid out the city of Billings, Mont., engaged in flood control work in Louisiana, and was active in the construction of the Mexican Central Railway. He went to California in 1887 and later served as city engineer of Los Angeles. Until within a few days of his death he was active as a consultant on a number of California projects.

George Copeland Urquhart (Assoc. M. '91) of Pittsburgh, Pa., died on January 10, 1939, at the age of 72. At the time of his retirement six years ago as general real estate agent of the Pennsylvania Railroad, Mr. Urquhart had been in railroad work almost fifty years. From 1884 to 1903 he was with the Pittsburgh, Cincinnati and St. Louis Railroad in various capacities. In the latter year he was named general real estate agent for the Pennsylvania Lines West of Pittsburgh, holding this position until 1920 when he became real estate agent of the Central Region.

In 1923 he was given the position that he held at the time of his retirement.

Sydney Bacon Williamson (M. '96) division engineer under Gen. George W. Goethals in the building of the Panama Canal, died in Lexington, Va., on January 13, 1939, at the age of 74. In 1892 Colonel Williamson gave up the private practice of engineering to enter the government service, becoming principal assistant to General Goethals on the Muscle Shoals Canal. He was engaged on this work until 1900, and from 1907 to 1912 he was engineer in charge of the Pacific Locks in the building of the Panama Canal. The canal completed, Colonel Williamson was appointed chief of construction of the U. S. Reclamation Service. He earned his title in the World War, when he was given command of the 55th Engineers of the A.E.F. His last public service was as a member of the Interoceanic Canal Board, to which he was appointed by President Hoover and from which he retired in May 1935.

Edmund Lee Zearley (M. '16) civil and mining engineer (the Fayette Engineering Company), Uniontown, Pa., died on December 29, 1938. He was 71. From 1895 to 1900 Mr. Zearley was with the McClure Coke Company, and from 1900 to 1902 with the H. C. Frick Coke Company. In the latter year he established his own practice (the Fayette Engineering Company), which was long active in the construction of mining and other structures.

The Society welcomes additional biographical material to supplement these brief notes and to be available for use in the official memoirs for "Transactions."

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From January 10 to February 9, 1939, Inclusive

Additions to Membership

Bader, John Adolf (Jun. '38), 309 East State St., Media, Pa.

Barksdale, John Fowler (Assoc. M. '38), Area Engr., TVA, 217 Federal Bldg., Chattanooga, Tenn.

Bassett, Donald Arthur (Jun. '38), 207 South Tremont St., Kewanee, Ill.

Bates, William Fulton (Jun. '38), Area Engr., WPA, Box 82, Greenville, Miss.

Branick, Wayne D. (Jun. '39), Res. Engr., WPA, Box 141 (Res., 506 East St. John), Girard, Kans.

Brod, Howard William (Jun. '38), Care, Hydraulics Section, U. S. Engr. Dept., 751 South Figueroa St., Los Angeles, Calif.

Burke, James Bastion (Assoc. M. '39), Engr. (Harrison G. White–James B. Burke), 9 Andrew St., Springfield, Mass.

Burton, James Edward (Jun. '38), Associate Engr., Grade C, State Highway Comm. (Res., 1716 Lane St.), Topeka, Kans.

Carper, William Hudson (Jun. '38), City Hall, Fredericksburg, Va.

Chamberlin, Carl Hal (Jun. '38), 233 Fifth St., Bremerton, Wash.

Cheves, Langdon (Jun. '38), Estimator, Townsend Lumber Co. (Res., 501 North McDuffie St.), Anderson, S.C.

Coates, John James (Jun. '39), 56 East 87th St., New York, N.Y.

Cocolicchio, Ernest William (Jun. '38), 356 East 116th St., New York, N.Y.

Conway, Gerald Richard (Jun. '38), 271 Beach 139th St., Rockaway Beach, N.Y.

Creacy, Thomas Nelson (Jun. '38), Care, Consolidated Builders, Inc., Mason City, Wash.

Dawson, Archibald (Jun. '38), 1803 East High St., Jefferson City, Mo.

Deewall, Lorin William (Assoc. M. '39), County Planning Engr., San Diego County Planning Comm. (Res., 4433 Arch St.), San Diego, Calif.

Dewante, Randolph Hoque (Jun. '38), 23439 South Garden Ave., Hayward, Calif.

Dodge, Earnest Farwell (Jun. '38), 4522 Brooklyn Ave., Seattle, Wash.

Draper, Elmond Llewallen (Jun. '38), Trail Locator, U. S. Dept. of Interior, CCC, Box 44, Tuba City, Ariz.

Duberg, John Edward (Jun. '38), 4140 Boyd Ave., New York, N.Y.

Erlenkotter, Robert (Jun. '39), With War Dept., Fort Belvoir, Va.

Ernst, George Campbell (Assoc. M. '39), Asst. Prof., Civ. Eng., Univ. of Maryland (Res., 220 College Ave.), College Park, Md.

Flanagan, Thomas Scott (Jun. '38), Field Engr., REA, 2713 South Smedley St., Philadelphia, Pa.

Frate, Charles Joseph (Jun. '38), 410 Federal Bldg., Chattanooga, Tenn.

Goodkind, Herbert (Jun. '38), Detailer, Ash-Howard-Needles & Tammen, 55 Liberty St., New York, N.Y. (Res., 10 Llewellyn Pl., New Brunswick, N.J.)

Goodwin, Richard Smith (Jun. '38), 422 West 6th St., East Liverpool, Ohio.

Gray, Edward Zigmund (Jun. '38), Junior Engr., U. S. Geological Survey, Pullman, Wash. (Res., 4236 North Colonial Ave., Portland, Ore.)

Guyton, William Franklin (Jun. '39), 250 South Euclid Ave., Pasadena, Calif.

Hiltabidle, William Orme, Jr. (M. '39), Lt.-Commander, C.E.C., U.S.N., Public Works Officer, Naval Air Station, San Diego, Calif.

Holmes, Robert Stratton (Jun. '38), Box 1907 Yale Station, New Haven, Conn.

Hoover, Lawrence Merril (Jun. '38), Fort Logan, Colo.

Hoxie, Wilbar Marden (Jun. '38), With U. S. Engr. Office, 53 Wesleyan Ave., Providence, R.I.

Johnson, Carl Burdett (Jun. '39), Asst. Eng. Aid, U. S. Engr. Dept., Los Angeles (Res., 1133 Formosa Ave., Hollywood), Calif.

Johnson, Elmer George (Assoc. M. '38), Box 87, Dowagiac, Mich.

Jones, Howell Carlisle (M. '39), Gen. Mgr., C. G. Fuller (Res., 131 Railroad Ave.), Barnwell, S.C.

Jones, Wilson Burdette (Jun. '38), Junior Eng. Aid, State Bridge Dept., 1100 South Benito St., Alhambra, Calif.

Kafka, Walter Adolph (Jun. '38), Superv. Traffic Engr., Town of Irvington, 406 Coit St., Irvington, N.J.

Kennedy, Robert Evan (Jun. '38), 1577 Jasmine, Denver, Colo.

Kneale, John Stephen, Jr. (Jun. '39), San. Engr., New York Water Service Corporation, New York (Res., 3520 Newkirk Ave., Apartment 1B, Brooklyn), N.Y.

Kroc, Richard John (Jun. '38), 1014 South Floyd St., Louisville, Ky.

Kubo, Giro Gerald (Jun. '38), Graduate Dormitory, Mass. Inst. Tech., Cambridge, Mass.

Lee, James Fook Lam (Jun. '38), With Big Eagle Creek Flood Control Project, 310 North Illinois St., Indianapolis, Ind.

Letsinger, Clarence Austin (Jun. '38), Field Engr., The Texas Co., Tulsa, Okla. (Res., 227 East Bennett St., Salem, Ill.).

Lockwood, John Donald (Assoc. M. '38), Asst. State Director, Div. of Operations, WPA of Louisiana, State Headquarters, 805 Canal Bank Bldg., New Orleans, La.

Lucas, Chester Laurice (Jun. '38), Junior Draftsman, State Highway and Public Works Comm. (Res., L-6 Raleigh Apartments), Raleigh, N.C.

Lyman, Albert Kualii Brickwood (M. '38), Col., Corps of Engrs., U.S.A., Dist. Engr., U. S. Engr. Office, 3d Floor, Park Sq. Bldg., Boston, Mass.

Macedonia, Charles Michael (Jun. '38), 209 Dyckman St., New York, N.Y.

McCoach, David, Jr. (M. '38), Col., Corps of Engrs., U.S.A., Engr. Commr., District of Columbia, Room 518, District Bldg., Washington, D.C.

McGaughy, John Bell (Jun. '38), Technical Asst., Civ. Engrs. Div., U. S. Coast Guard, Norfolk, Va.

McLea, Duncan Kennedy (Jun. '38), Box 3324, Johannesburg, Union of South Africa.

McMordie, Robert Campbell (Assoc. M. '39), Structural Engr., H. G. Acres & Co., Ltd., Main and Ferry Sts., Niagara Falls, Ont., Canada.

Marshall, Arthur Philip (Jun. '39), 51-01 One Hundred and Second St., Corona, N.Y.

Miller, Clarence Harold (Assoc. M. '39), Engr., U. S. Engr. Office, 3 Carlton St., Binghamton, N.Y.

Moore, Norman Harned (Jun. '38), 3 Oak St., College Heights, Hyattsville, Md.

Moore, Walter Leon (Jun. '38), Junior Eng. Aid, U. S. Eng. Div., 751 South Figueroa St., Los Angeles (Res., 246 South Grand Oaks Ave., Pasadena), Calif.

Newsome, Richard Cecile (Jun. '38), 810 Colquitt St., Houston, Tex.

O'Connor, Walter Francis (Jun. '38), Insp., State Highway Comm., Box 150, Greenfield (Res., 812 Nichol Ave., Anderson), Ind.

Odlen, Martin (Jun. '38), Structural Salesman and Estimator, Gen. Iron Works, 407 Atlantic Ave., Camden, N.J.

TOTAL MEMBERSHIP AS OF FEBRUARY 9, 1939

Members	5,638
Associate Members	6,280
Corporate Members	11,918
Honorary Members	27
Juniors	3,859
Affiliates	74
Fellow	1
Total	15,879

Olin, Sexton Arthur (Jun. '39), 727 Livingston Hall, Columbia Univ., New York, N.Y.

Orsini, Felice Marino (Assoc. M. '39), Regional Chf. Draftsman, U. S. Dept. of Agriculture, SCS (Res., 556 Woodland St.), Spartanburg, S.C.

Parrish, Charles Raymond, Jr. (Jun. '39), Insp., U. S. Engrs., Box 22, Sardis, Miss.

Pattison, Martin Oren (Jun. '38), Rodman, State Highway Comm., 421 North Juliette Ave., Manhattan, Kans.

Plummer, Albert William (Jun. '38), 1933 Fulton St., Fresno, Calif.

Plummer, Raymond Benton (Assoc. M. '38), Designing Engr., Indianapolis Water Co. (Res., 5914 East Washington St.), Indianapolis, Ind.

Purchase, Roy Wade (June. '38), With Dept. of Eng., City of Hartford (Res., 32 Wethersfield Ave.), Hartford, Conn.

Raymond, Henry Sherrick (Jun. '38), Trail Locator, CCC, Dept. of Interior, 533 West Palm Lane, Phoenix, Ariz.

Richardson, Robert Llewellyn (Jun. '38), Junior Steel Insp., Testing Laboratory, State Div. of Highways (Res., 1424 N St.), Sacramento, Calif.

Roberts, James Waid (Jun. '38), 2470 Washington St., San Francisco, Calif.

Rodriguez, Güillermo (Jun. '38), Box 516, Ancon, Canal Zone.

Rowan, Lawrence (Jun. '39), 104 Seventh Ave., S.E., Aberdeen, S.Dak.

Rozelle, Newell Arthur (Jun. '39), 106 South Hill Terrace, Ithaca, N.Y.

Saint Malo, Alberto de (Jun. '39), Structural Designer, Grebien & Martinz, Inc., Box 515, Panama, Panama.

Sawchuk, Henry Avery (Jun. '39), Public Service Interne, with Board of Water Supply, New York City, New York (Res., 1716 Fifty-first St., Brooklyn), N.Y.

Sear, Thomas Benjamin (Jun. '38), Engr., Bethlehem Steel Co., 400 North Michigan Ave., Chicago (Res., 202 First Ave., Joliet), Ill.

Seifried, Charles Frank (M. '39), Supt., State Highway Dept. (Res., 2900 Reed Ave.), Cheyenne, Wyo.

Sheehan, William Michael (Jun. '39), 66 James Court, Howard Beach, N.Y.

Sheehy, Patrick Joseph (Jun. '38), 80 State St., Augusta, Me.

Sheets, Frank Thomas, Jr. (Jun. '38), 21 East Mann Ave., Osborn, Ohio.

Short, John August (Jun. '38), Junior Hydr. Engr., U. S. Geological Survey (Res., 1200 Spring Ave.), Rolla, Mo.

Simmons, Darrell Raymond (Jun. '38), Res. Engr., C. H. Guernsay, Cherokee, Okla.

Simpson, Willard Eastman, Jr. (Jun. '38), With State Highway Dept., 1211 West Woodlawn Ave., San Antonio, Tex.

Skrla, Thomas Branch (Jun. '38), 201 West 10th St., Austin, Tex.

Stanton, Robert Louis (Jun. '38), Care, F. C. D. Company A, Randolph Field, Tex.

Stern, Sylvan Philip (Jun. '38), 2428 North 19th St., Philadelphia, Pa.

Stevenson, DeWitt Alexander (Jun. '38), 1410 Peachtree St., Apartment C-10, Atlanta, Ga.

Stribling, William John (Assoc. M. '39), Res. Engr., Frank T. Miller, Investment Bldg., Greensboro (Res., 748 North Main St., High Point), N.C.

Stuart, Wilbur Tennant (Jun. '39), Res. Engr., U. S. Geological Survey, Box 185, Grand Canyon, Ariz.

Sushka, Peter (Jun. '39), Eng. Draftsman, Dept. of Agriculture, SCS (Res., 1259 New Hampshire Ave.), Washington, D.C.

Thornburg, Alvan Ziegler (Jun. '38), 119 Chestnut St., Whittier, Calif.

Tracey, Frank Aloysius (Assoc. M. '38), Senior Hydrographic Engr., New Jersey Board of Commerce and Nav., 1060 Broad St., Newark (Res., 1319 Murray Ave., Plainfield), N.J.

Travis, Charles French (Assoc. M. '38), Associate Engr., North Atlantic Div. Office, U. S. Engr. Office, 80 Broad St., 14th Floor, New York, N.Y.

Van Giesen, William Orsen (Assoc. M. '39), Capt., Corps of Engrs., U.S.A., Officer in Chg., Whitney Point Dam, U. S. Engr. Office, Security Mutual Bldg., Binghamton, N.Y.

Vitolo, Francis Adams (Jun. '38), Asst. Field Engr., Cauldwell-Wingate & Co. (Res., 4707 Delafield Ave.), New York, N.Y.

Vrachos, Christopher (Jun. '39), 40 Mansfield St., Gloucester, Mass.

Weeshoff, Gerard Christian (Jun. '38), Care, U. S. Engr. Dept., Federal Bldg., Sacramento, Calif.

Weiner, Daniel Jeannot (Jun. '38), 2313 Avalon Ave., Baltimore, Md.

Weisshaupt, William Jonathan (Jun. '39), Junior Engr., Morrison-Knudsen Co., Inc., Box 298, Hood River, Ore.

Wells, Homer Magee (M. '38), Hydr. Engr., Bureau of Agri. Economics, U. S. Dept. of Agriculture (Res., 1830 Kay St., N.W., Apartment 401), Washington, D.C.

Weston, Roy Francis (Jun. '39), 2277 Andrews Ave., New York, N.Y.

Winkelholz, William Ray (Jun. '38), 615 Dewey Ave., Bartlesville, Okla.

Membership Transfers

Beattie, Kenneth William (Jun. '27; Assoc. M. '38), Research Engr., Baldwin-Southwark Corporation, I. P. Morris Div. (Res., 4516 Chestnut St.), Philadelphia, Pa.

Borland, Whitney McNair (Jun. '31; Assoc. M. '38), Associate Engr., U. S. Bureau of Reclamation, U. S. Custom Bldg., Denver, Colo.

Camp, Cecil Sidney (Jun. '31; Assoc. M. '39), Asst. Prof., Civ. Eng., Coll. of Applied Science, Syracuse Univ., Syracuse, N.Y.

Crawford, Robert Earl (Jun. '28; Assoc. M. '38), Asst. Engr., Bridges, So. Ry. (Res., 3303 Lansing Ave.), Knoxville, Tenn.

Geyer, John Charles (Jun. '33; Assoc. M. '38), Associate in Civ. Eng., The Johns Hopkins Univ., Latrobe Hall, Johns Hopkins Univ., Homewood, Baltimore, Md.

Holt, Marshall (Jun. '27; Assoc. M. '39), Research Engr., Aluminum Research Laboratories, Box 772, New Kensington (Res., 1713 Victoria Ave., Arnold), Pa.

James, Roger Thomas (Assoc. M. '24; M. '39), Asst. City Engr., City Hall (Res., 1624 Elizabeth Ave.), Charlotte, N.C.

Johnson, Joe William (Jun. '35; Assoc. M. '39), Asst. Hydr. Engr., SCS, U. S. Dept. of Agriculture, 717 Columbian Bldg., Washington, D.C.

Leap, Clifford Raymond (Jun. '31; Assoc. M. '39), Engr., Louisville Cement Co., Box 147, Speed, Ind.

Regester, Robert Thomas (Jun. '22; Assoc. M. '30; M. '39), Associate Engr., Whitman, Requardt & Smith, West Biddle St. at Charles (Res., 401 East Gittings Ave., Cedarcroft), Baltimore, Md.

Rugg, Warren Fuller (Assoc. M. '07; M. '39), Asst. Engr., New York City Planning Comm., 2700 Municipal Bldg. (Res., 5 Prospect Pl., Tudor City), New York, N.Y.

Silverman, Isadore Karl (Jun. '30; Assoc. M. '38), Asst. Engr., U. S. Bureau of Reclamation, New Customs House, Denver, Colo.

Simpson, Paul Dyer (Assoc. M. '07; M. '39), Cons. Engr., John D. Rockefeller, Jr., Seal Harbor, Me.

Stirman, Harry Hill (Jun. '36; Assoc. M. '39), With City Eng. Dept., City Hall (Res., 2513 Cleo St.), Corpus Christi, Tex.

Stockbridge, Glenn Henry (Jun. '27; Assoc. M. '39), Asst. Chf. Engr., Kern County Land Co., Box 380 (Res., 2519 Sunset Ave.), Bakersfield, Calif.

Story, John Wilson (Jun. '29; Assoc. M. '39), Structural Engr., Commonwealth & Southern Corporation (Res., 742 Carlton Boulevard), Jackson, Mich.

Tessitor, Ernest (Jun. '29; Assoc. M. '39), Designer, Allegheny County Dept. of Works, County Office Bldg., Pittsburgh (Res., 625 Broad St., Sewickley), Pa.

Ware, Walter Justus (Jun. '31; Assoc. M. '38), Asst. Engr., U. S. Engr. Office, 303 Mfg. Exchange Bldg., Kansas City, Mo.

Woodburn, James Gelston (Assoc. M. '29; M. '39), Prof., Hydr. Eng., Univ. of Wisconsin (Res., 211 North Prospect Ave.), Madison, Wis.

Reinstatements

Bayliss, Paul, M., reinstated Jan. 16, 1939.

Boetzkes, Harry William, M., reinstated Jan. 13, 1939.

Davidson, Harold Nils, Jun., reinstated Feb. 8, 1939.

Eisenhuth, Harold Paul, Assoc. M., reinstated Jan. 9, 1939.

Flebus, Carlo Giuseppe, Assoc. M., reinstated Jan. 17, 1939.

Grazulis, Albert Charles, Jun., reinstated Jan. 12, 1939.

Gregory, William Benjamin, M., reinstated Jan. 12, 1939.

King, Harry Lindley, Jun., reinstated Jan. 13, 1939.

Kramer, Robert William, Jun., reinstated Feb. 8, 1939.

Maca, Leon Francis, Assoc. M., reinstated Jan. 9, 1939.

Mackey, Lincoln, Assoc. M., reinstated Jan. 19, 1939.

Maguire, Michael, Assoc. M., reinstated Feb. 1, 1939.

Nelson, Ernest Benjamin, Assoc. M., reinstated Jan. 9, 1939.

Palmer, Wayne Francis, Assoc. M., reinstated Feb. 9, 1939.

Quade, Maurice Northrop, Assoc. M., reinstated Jan. 30, 1939.

Ray, Frederick Chamberlain, Assoc. M., reinstated Jan. 24, 1939.

Scott, Robert Howard, Assoc. M., reinstated Jan. 16, 1939.

Wilson, Everitt Wyche, M., reinstated Jan. 20, 1939.

Resignations

Anderson, Paul Otto, Jun., resigned Feb. 6, 1939.

Bateman, John Henry, M., resigned Jan. 20, 1939.

Borchelt, Thomas Charles, Jun., resigned Feb. 6, 1939.

Burnley, Seth, Assoc. M., resigned Jan. 9, 1939.

Carey, Harold Nevin, Jun., resigned Jan. 16, 1939.

Cavanagh, William Curran, Jr., Assoc. M., resigned Jan. 9, 1939.

Cutter, Howard Davis, Jr., Assoc. M., resigned Jan. 30, 1939.

Drachman, Allen Ogden Rice, Jun., resigned Jan. 9, 1939.

Drury, William George, Assoc. M., resigned Feb. 8, 1939.

Edmonds, Donald John, Jun., resigned Jan. 9, 1939.

Eichin, Henry, Assoc. M., resigned Feb. 6, 1939.

Ellarson, Richard Lawrence, Jun., resigned Jan. 20, 1939.

Enns, Everett Byron, Jun., resigned Jan. 20, 1939.

Froseth, Olaf, M., resigned Feb. 6, 1939.

Hammond, George Warren, Jun., resigned Jan. 25, 1939.

Hassenmiller, Wilford Sowle, Assoc. M., resigned Jan. 25, 1939.

Jensen, Ray, Jun., resigned Jan. 20, 1939.

Lantay, George Sylvester, Jun., resigned Jan. 20, 1939.

Malchow, Carter Dana, Jun., resigned Jan. 16, 1939.

Mansell, Benjamin Thomas, Assoc. M., resigned Feb. 3, 1939.

Mononobe, Nagaho, M., resigned Feb. 8, 1939.

Moravec, James Guilford, Jun., resigned Jan. 11, 1939.

Newman, Walter Charles, Jr., Jun., resigned Jan. 9, 1939.

Orr, James Lawrence, M., resigned Jan. 9, 1939.

Runner, Harold Vernon, Jun., resigned Jan. 9, 1939.

Schad, Bernard Theodore, Assoc. M., resigned Jan. 9, 1939.

Spurling, Oliver Cromwell, M., resigned Feb. 6, 1939.

Statham, William Harold, Assoc. M., resigned Feb. 8, 1939.

Applications for Admission or Transfer

Condensed Records to Facilitate Comment from Members to Board of Direction

March 1, 1939 NUMBER 3

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years	5 years RCM*
Associate Member	Qualified to direct work	27 years	8 years	1 year RCA*
Junior	Qualified for sub-professional work	20 years	4 years	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years	5 years RCM*

* In the following list RCA (responsible charge—Associate Member standard) denotes years of responsible charge of work as principal or subordinate, and RCM (responsible charge—Member standard) denotes years of responsible charge of IMPORTANT work, i. e., work of considerable magnitude or considerable complexity.

FOR MEMBER

ALLIN, RAY LESTER (Assoc. M.), San Francisco, Calif. (Age 51) (Claims RCA 1.2 RCM 23.6) Sept. 1923 to date Hydr. Engr., Hetch Hetchy Project, until Jan. 1932 with Dept. of Public Works, and since then with Bureau of Eng., Public Utilities Comm.

APPLEFORD, CARL WILLIAMS (Assoc. M.), San Francisco, Calif. (Age 46) (Claims RCA 9.0 RCM 6.0) May 1920 to date with Pacific Gas & Elec. Co., on structural design of power house, substation and other buildings, transmission-line structures, etc., for steam and water-power development.

BROWN, WILLIAM CARLTON, Alameda, Calif. (Age 45) (Claims RCA 6.3 RCM 8.0) Oct. 1934 to date Engr. Inspector, FEA of PW (PWA), on construction of water-works improvements in San Francisco; May 1933 to Oct. 1934 unemployed.

CALKINS, HAROLD ALMON, San Francisco, Calif. (Age 47) (Claims RCA 13.7 RCM 10.0) July 1924 to date with California Packing Corporation as Field Engr., Senior Asst. Engr., and (since March 1938) Chf. Engr., in charge of all engineering.

CANNELL, PAUL JOHN (Assoc. M.), Hastings, Nebr. (Age 47) (Claims RCA 7.5 RCM 10.2) Dec. 1935 to date with The Central Nebraska Public Power & Irrigation Dist., successively as Designer, Field Office Designer, and (at present) Designer, acting as First Asst. to Chf. Designer; previously Bridge Designer, Bridge Dept., Bureau of Roads and Bridges, State of Nebraska.

CUNNINGHAM, CHARLES HOLMES, New York City. (Age 45) (Claims RC 9.1 D 9.1) Sept. 1922 to date Commissioned Officer, U. S. Army from grade of 2d Lieut. to Lt. Col.; since June 1937 being Asst. to Div. Engr., North Atlantic Div., U. S. Div. Engr. Office; previously Instructor, The Engr. School, Fort Belvoir, Va.; Corps Area Engr., 7th Corps Area, Omaha, Nebr., in charge of engineer troop training and operations.

DUNSING, WILLIAM JOSEPH, Woodhaven, N.Y. (Age 60) (Claims RCM 28.8) March 1907 to date with Topographical Bureau, Queens, as Transitman, Computer, and Asst. Engr. in charge of various field work, and (at present) in charge of Street Opening Drafting Div.

ELLINGTON, HAROLD SLAIGHT, Detroit, Mich. (Age 53) (Claims RC 28.0 D 16.5) 1933 to 1936 Pres., and 1936 to date co-partner, Harley & Ellington, Inc., Archts. and Engrs.; previously co-partner, Weston & Ellington.

EPPS, THAD CHANDLER (Assoc. M.), Neenah, Wis. (Age 38) (Claims RCA 3.4 RCM 11.7) Jan. 1936 to date Structural Engr., Kimberly-Clark Corporation; previously Bldg. Inspector, PWA, Minneapolis, Minn., on field inspection of general construction, etc.; Associate Structural Engr., Procurement Div., Public Works Branch, U. S. Treasury Dept., Washington, D.C.

FITCH, JOHN DOUGLASS (Assoc. M.), Washington, D.C. (Age 35) (Claims RCA 3.0 RCM 9.8) Jan. 1934 to date with Federal Power Comm., until April 1938 as Engr. (Grade P-4), and since May 1938 Senior Engr. (Grade P-5).

HERTZ, ALBERT LESLIE (Assoc. M.), Johnstown, Pa. (Age 41) (Claims RCA 4.0 RCM 8.8) Aug. 1938 to date Res. Engr., Corps of Engrs., U. S. Army, on $7,000,000 channel improvement; Jan. 1928 to Aug. 1938 with Municipal Eng. Div., Panama Canal, successively as Surveyor, Jun. Engr., in charge of construction of ferry landing, concrete dry-dock, etc., Asst. to Mun. Engr., and (at present) Res. Engr.

KEELER, KARL FAIRBANKS, El Paso, Tex. (Age 51) (Claims RC 20.0 D 1.0) June 1932 to date with International Boundary Comm., United States and Mexico, as Associate Engr., and (since March 1937) Hydr. Engr.

KUYL, HENRY GEORGE, Washington, D.C. (Age 46) (Claims RC 18.6 D 18.0) Feb. 1929 to date Prin. Engr., Board of Engrs. for Rivers and Harbors, War Dept., investigating proposed river and harbor improvement projects.

LEWIS, CHARLES FREDERICK, Knoxville, Tenn. (Age 52) (Claims RCA 7.2 RCM 11.4) May 1928 to date (except Jan. 1936 to July 1938) Mgr. and Chf. Engr., Volunteer Portland Cement Co.; in the interim with Puerto Rico RA, Washington, D.C., and San Juan, Puerto Rico, consulting on building of cement plant at Catana, P.R.

MEYER, CARL FREDERICK (Assoc. M.), Worcester, Mass. (Age 39) (Claims RCA 8.0 RCM 6.7) Sept. 1924 to date with Civ. Eng. Dept., Worcester Polytechnic Inst., 5 years as Instructor, 9 years Asst. Prof. (5 years with responsibilities equivalent to Associate Prof.), and (since July 1938) Prof.; Sept. 1936 to June 1937 Exchange Prof. of Eng., Univ. of Hawaii.

MUNDAL, TORALD, Knoxville, Tenn. (Age 41) (Claims RCA 4.0 RCM 6.0) July 1934 to date with TVA, as Associate Hydr. Engr., Hydr. Engr., and (since April 1937) Senior Civ. Engr.; previously Design Engr., W. S. Lee Eng. Corporation.

PENNA, NICHOLAS CHARLES RICHARD (Assoc. M.), Harrison, N.Y. (Age 35) (Claims RCA 4.0 RCM 8.9) Nov. 1935 to date Inspector, Res. Engr. and Chf. Inspector, Madigan-Hyland, Cons. Engr., Long Island City, N.Y., having charge of construction of bridges on Henry Hudson Parkway, etc.; previously Senior Draftsman, Senior Engr. of Constr., Park Dept., Borough of Bronx, New York City.

POLIVKA, JAROSLAV, New York City. (Age 52) (Claims RCA 1.9 RCM 26.5) At present on construction of Czechoslovak Pavilion, World's Fair, New York, 1939; May to Dec. 1919 and Jan. 1926 to Dec. 1938 Civ. Engr., Prague, on reinforced concrete design and construction; in the interim Associate and Tech. Director, Ing. Vlad, Vlcek, Inc., Civ. Engrs.

POST, CLARENCE WILLARD (Assoc. M.), Albany, N.Y. (Age 52) (Claims RCA 4.1. RCM 22.2) July 1935 to date Deputy State Administrator and Chf. Engr., WPA, New York State—organized and administered the Operations Div., etc.; previously with James McKinney & Sons, on designing, estimating, and selling structural steel, etc.; Chf. Engr., Albany County CWA.

REYNOLDS, JAMES ROBERT, Norfolk, Va. (Age 34) (Claims RC 7.1 D 4.3) Aug. 1935 to date with U. S. Engr. Dept., as Jun. Engr. (being Chf. of Party), and (since Feb. 1936) Asst. Engr.; previously Photogrammetist, U. S. Coast & Geodetic Survey.

RUDD, EDWARD IRVINE, Hartford, Conn. (Age 60) (Claims RC 28.4 D 4.0) Sept. 1917 to date Engr. and Chf. Engr., Public Utilities Comm. of Connecticut, inspecting and reporting on steam and electric railways, gas and electric plants, etc.

SAIN, KANWAR, LAHORE, Punjab, India. (Age 40) (Claims RC 6.8 D 9.1) Oct. 1922 to date with Punjab Irrigation Dept., as Apprentice Engr., Asst. Executive Engr., Executive Engr., and (since May 1937) Director, Central Designs, Haveli Project, having charge of all designs, etc.; also Under Secy. to Govt., Punjab Irrigation Branch.

SCHUMAN, EVERETT CARLYLE, Chicago, Ill. (Age 36) (Claims RCA 3.2 RCM 7.7) 1938 to date Chairman, Dept. of Civ. Eng., Lewis Institute; previously Associate Engr., Research Laboratory, Portland Cement Association, in charge of design and investigations, etc.

SMEED, HAROLD FRANKLIN (Assoc. M.), Albany, N.Y. (Age 50) (Claims RCA 8.0 RCM 10.8) Aug. 1935 to date State Director of Operations, WPA, New York State, in responsible charge of Div. of Operations, etc.; previously Dist. Engr. for TERA, New York State; member of firm, Smith & Smeed, Rochester, N.Y.

WEHNER, STEPHEN, Park Ridge, Ill. (Age 53) (Claims RC 19.3 D. 15.0) Oct. 1917 to date with Public Utility Eng. & Service Corporation, Chicago, Ill., as Designing Engr., Asst. Hydr. Engr., and Hydr. Engr., on hydroelectric and water-supply projects.

FOR ASSOCIATE MEMBER

ACREE, GEORGE, Kansas City, Mo. (Age 37) (Claims RCA 4.4 RCM 0.0) Nov. 1929 to Jan. 1932, Oct. 1933 to Jan. 1934, and Nov. 1935 to date Engr., Ash-Howard-Needles & Tammen; previously Designer, Burns and McDonnell Eng. Co.; Designer, Bridge Dept., Kansas State Highway Dept.; Draftsman, Sebastian Patti Constr. Co.; Draftsman, Harrington & Cortelyou; with U. S. Engr. Office, mapping and designing structures for Ft. Peck Dam and Spillway.

Adland, Edwin Ralph, Waterloo, Iowa. (Age 34) (Claims RC 5.7) Sept. 1933 to date with U. S. Engr. Office, Rock Island, Ill., Surveyman, Jun. Engr., and Asst. Engr., being Field Supervisor.

Bauer, John Harold, Natick, Mass. (Age 31) (Claims RC 1.9) June 1930 to date with Metropolitan Dist. Water Supply Comm., as Rodman, Inspector, Instrumentman, and since Sept. 1935 Senior Eng. Aid.

Beer, Justin Squires, Brooklyn, N.Y. (Age 30) (Claims RCA 3.0 RCM 0.0) March 1937 to date Engr., E. J. McCormick, Inc.; previously Special Agent, Div. of Investigations, FEA of PW, making engineering investigations and reports, etc.; Asst. Supt., B. Turecamo Contr. Co., Inc., Paving Contrs.

Bole, James Renwick (Junior), Long Beach, Calif. (Age 31) (Claims RCA 4.2 RCM 0.0) Nov. 1933 to date with J. H. Davies, Cons. Engr., as Structural Draftsman, and since Nov. 1934 Structural Engr., in charge of designing office, etc.; previously with Bethlehem (Pa.) Steel Co., as Structural Steel Draftsman, Checker, Estimator, and Designer.

Boswell, Leo Delbert (Junior), Tulsa, Okla. (Age 33) (Claims RCA 1.3 RCM 0.0) June 1937 to date Draftsman and Designer, until Aug. 1938 with American Steel Derrick Co., and since Aug. 1938 with Tulsa Boiler & Machinery Co.; previously at Oklahoma Agricultural & Mechanical Coll., as Asst., Asst. in charge, and Student Instructor in surveying; member of firm, Southwest Map & Blueprint Co.

Boucher, Raymond (Junior), Montreal, Que., Canada. (Age 32) (Claims RC 4.4) Sept. 1934 to date with Polytechnic School of Montreal, as Asst. Prof. of Hydraulics, and (since April 1937) Associate Prof. of Hydraulics.

Brown, Francis Leo (Junior), Ft. Edward, N.Y. (Age 29) (Claims RCA 3.4 RCM 1.5) Aug. 1937 to date Supt. of Highways, Washington County, N.Y.; previously Supt., Constr. Div., Buffalo, N.Y.; Asst. Res. Engr., PWA, being Res. Engr. on 15 projects in western New York State, etc.

Callahan, Felix Wood (Junior), San Angelo, Tex. (Age 31) (Clams RCA 5.6 RCM 0.8) July 1935 to date Supervisor of Operations, WPA, Dist. No. 19 in charge of all construction operations, etc.; previously Rural Work Supervisor and Dist. Work Mgr., Texas Relief Comm., Austin, Tex.; Engr., Dept. of Interior, National Park Service, Grayson County, Tex.

Charles, Robert Simpson, Jr., London, Ont., Canada. (Age 29) (Claims RCA 4.0 RCM 2.4) Sept. 1936 to date Field Engr., International Water Supply, Ltd.; previously Field Engr., successively with Société Française de Forages, Layne, France, Sociétié L'Hydraulique-Afrique, and Sociétié L'Hydraulique-Asie; Research Engr., Layne New York Co., Inc.

Clapp, Nathaniel (Junior), Palmer, Mass. (Age 32) (Claims RCA 5.1 RCM 0.0) Dec. 1938 to date Field Engr., Metcalf & Eddy, Boston, Mass.; previously in private practice, municipal engineering and surveying; Chf. of Party, U. S. Coast & Geodetic Survey; member of Res. Engr.'s Staff, City of Springfield, Mass.

DiGiacinto, Albert George (Junior), Elmsford, N.Y. (Claims RCA 0.5 RCM 3.8) Sept. 1937 to date Engr., Spencer, White & Prentis, Inc., Contrs. & Engrs. on Construction of section of Sixth Ave. Subway for City of New York, etc.; previously Engr., Eng. Constr. Corporation, Alton, Ill. Engr., C. R. Vanneman, Inc., Engrs., Albany, N.Y.

Eaton, William Robert, Chattanooga, Tenn. (Age 34) (Claims RCA 8.6 RCM 0.0) June 1929 to date with U. S. Geological Survey, Chattanooga, Tenn., and Washington, D.C., as Jun. Engr., and (since June 1930) Asst. Engr.

Ecker, John Beard (Junior), Chevy Chase, Md. (Age 32) (Claims RCA 6.2 RCM 0.0) Nov. 1933 to date with Capital Transit Co., Washington; D.C., as Prin. Asst. Engr., and (since Jan. 1938) as Research Engr.

Elliot, Reed Archer, Fountain City, Tenn. (Age 29) (Claims RCA 2.2 RCM 0.0) Aug. 1935 to date with TVA as Jun. Eng. Aide, Eng. Aide, Jun. Hydr. Engr., and (since July 1938) Asst. Hydr. Engr.; previously Tech. Supervisor, under City Engr., Medford, Mass.; Chf. of Survey Party, ERA, Medford, Mass.

Endebrock, Frank Louis, Norris, Tenn. (Age 33) (Claims RC 3.7 D 4.3) July 1936 to date Asst. Structural Engr., TVA, Knoxville, Tenn.; previously Asst. City Engr., St. Joseph, Mo., designing, estimating, and supervising construction of municipal projects; Jun. Engr., U. S. Bureau of Reclamation, Denver, Colo.

Felker, Franklin Mechtley (Junior), Lewistown, Pa. (Age 30) (Claims RCA 4.9 RCM 1.2) Dec. 1937 to date with Pennsylvania Dept. of Forests and Waters, Flood Control Bureau, Harrisburg, Pa., as Asst. Flood Engr., on research and investigations, design of channels, etc.; previously with U. S. Dept. of Agriculture, Forest Service, Washington, D.C., as Jun. Engr., Asst. Engr. (Truck Trail Locator), and Asst. Engr. (Div. Engr.).

Fiesenheiser, Elmer, St. Paul, Minn. (Age 32) (Claims RCA 3.1 RCM 0.0) Oct. 1935 to date with U. S. Bureau of Public Roads, as Jun. Highway Engr., and (since Sept. 1937) Asst. Highway Bridge Engr.; previously Eng. Draftsman, Truscon Steel Co., Youngstown, Ohio.

Glenn, Howard Allen, West Orange, N.J. (Age 44) (Claims RC 15.9) Jan. 1938 to date Gen. Supt., Standard Bitulithic Co., New York City, in charge of contract work and estimating for asphaltic and concrete paving; previously Gen. Supt., H. Lem White, Inc., Haddonfield, N.J., on highway construction; Gen. Supt., Edw. H. Ellis, Inc., Westville, N.J., highways and bridges.

Gribbin, John Breslin (Junior), Utica, N.Y. (Age 32) (Claims RCA 3.8 RCM 0.6) Sept. 1938 to date, Teacher, Utica Board of Education; Dec. 1937 to June 1938 private research work; previously Structural Designer, successively with Phoenix Eng. Co., and Fred Page Contr. Co.; Jun. Engr., U. S. RA, Washington, D.C.; Architectural Draftsman, New Jersey State Finance Dept.

Gustafson, Edward William, Fillmore, Calif. (Age 31) (Claims RC 2.1 D 0.1) May 1931 to date with California Dept. of Public Works, Div. of Highways, as Jun. Field Aid, Jun. Bridge Engr., Bridge Dept., and (since Jan. 1936) Asst. Bridge Engr., etc.

Hunter, Hubert Shipley, Tucson, Ariz. (Age 28) (Claims RC 5.8) March 1935 to date Jun. Hydr. Engr. (civil service), Water Resources Branch, U. S. Geological Survey; previously Senior Inspector, International Boundary Comm., U. S. and Mexico, American Sec., El Paso, Tex.

Iorns, William Vaughn (Junior), Idaho Falls, Idaho. (Age 32) (Claims RCA 6.6 RCM 0.5) June 1929 to date with U. S. Geological Survey, as Jun. Hydr. Engr., and Asst. Hydr. Engr., also Asst. to Watermaster, Dist. No. 36.

Iserguin, George Serge, San Francisco, Calif. (Age 32) (Claims RCA 1.2 RCM 0.0) April 1933 to Sept. 1936 and July 1938 to date with State of California, as Jun. Highway Engr., Jun. Bridge Engr., Asst. Res. Engr., etc., and (at present) Constr. Supt., S.R.A., designing camps and sewage disposal.

Johnson, Charles James (Junior), Portland Ore. (Age 32) (Claims RCA 4.1 RCM 0.4) Dec. 1938 to date Engr. and Estimator, Hammond Eng. Co.; previously Estimator and Engr. Geo. H. Buckler Co.; Inspector and Asst. Engr. with U. S. Engrs.; Supt. of Constr. with Ertz Burns Co.; with Lindström and Fiegenson, having charge of construction of Clatskanie and Youngs Bay (Astoria, Ore.) Bridges.

Justin, Joel Bates, Pulaski, Va. (Age 31) (Claims RCA 2.7 RCM 0.4) Feb. 1934 to date with TVA, as Recorder, Chf. of Party, Area Chf., and (since Sept. 1938) Supt. of Operation, Claytor Hydro Project for Appalachian Elec. Power Co.

King, Harry Lindley (Junior), Belleville, Ill. (Age 32) (Claims RC 6.0 D 5.0) Sept. 1927 to date with Illinois Div. of Highways, Bridge Office, as Jun. Highway Engr., since March 1929 designing highways and culverts, and acting as Res. Engr. on paving, grading, and bridge projects.

Krumm, Eric Tahlman (Junior), Columbus, Ohio (Age 27) (Claims RCA 3.4 RCM 0.4) March 1935 to date San. Engr. with Burgess and Niple, Cons. San. Engrs.; previously Field Engr., FERA, Franklin County, Ohio.

MacDonald, Donald Newell, Sacramento Calif. (Age 35) (Claims RCA 7.7 RCM 0.0) March 1923 to date with Southern Pacific Co., as Instrumentman, Office Engr., and (since Jan. 1938) Asst. Engr.

Martin, Robert Olof Roland (Junior), Albany, N.Y. (Age 32) (Claims RCA 3.0 RCM 0.0) July 1930 to date with U. S. Geological Survey, Water Resources Branch, as Jun. Hydr. Engr., and (since July 1935) Asst. Hydr. Engr.

Maschmeyer, William Louis (Junior), Sardis, Miss. (Age 32) (Claims RCA 5.5 RCM 0.3) Sept. to Dec. 1932, May to Sept. 1934 and April 1935 to date with U. S. Engrs., successively as Inspector, Levee Inspector, Jun. Engr., and (at present) Asst. Engr.

Medley, Reuben Duval, Frankfort, Ky. (Age 40) (Claims RC 10.5 D 8.3) June 1923 to Sept. 1928 and June 1929 to date with Kentucky State Highway Dept., successively as Rodman, Instrumentman, Inspector, Field Draftsman, Res. Engr., Draftsman, Squad Leader, and (since March 1931) Chf. Draftsman, acting as Prin. Highway Engr.

Meyer, Harry, Buffalo, N.Y. (Age 38) (Claims RC 11.5) Aug. 1921 to date with Corps of Engrs., U. S. Army, successively as 2d Lieut., 1st Lieut., and since Aug. 1935 Capt., on military engineering, etc.

Mihelchich, Edward Steven, Detroit, Mich. (Age 40) (Claims RCA 12.0 RCM 0.0) March 1927 to date Jun. Structural Engr., City Engr.'s Office, on structural design of sewage-pumping stations, sewers, swimming pools, airport hangars, etc.

Moore, William James, Clayton, N.Y. (Age 28) (Claims RCM 3.6) Aug. 1935 to date with Dept. of Interior, National Park Service, Fishers Landing, N.Y.; prior to student work with New York State Dept. of Public Works as Eng. Asst. and Jun. Asst. Engr.

Nicholson, Fred Archie, San Francisco, Calif. (Age 33) (Claims RCA 1.8 RCM 0.0) April 1936 to date Structural Draftsman and Detailer, San Francisco–Oakland Bay Bridge, State of California, on various work; previously with Div. of Highways, State of California, in Dists. 1 and 4.

Norton, John Comstock (Junior), Royal Oak, Mich. (Age 28) (Claims RC 1.9) Aug. 1936 to date member of firm, Heldt & Norton, Gen Contrs., in charge of engineering and construction; Feb. to Sept. 1937 also Structural Designer, Smith, Hinchman & Grylls; previously Statistical Engr., Michigan State Highway Dept., Highway Planning Survey, Lansing; Asst. to Asst. Director, Michigan WPA, Lansing.

Palmberg, Herbert George, Scappoose, Ore. (Age 30) (Claims RC 2.7 D 0.7) Oct. 1934 to date with U. S. Engrs., as Jun. Engr., and (since Aug. 1936) Asst. Engr.; previously Chairman, Computer and Transit-Rodman, Oregon State Highway Dept.

Prest, Kenneth Wallace (Junior), Tampa, Fla. (Age 32) (Claims RCA 3.2 RCM 3.5) July 1935 to Oct. 1937 and June 1938 to date with PWA as Field Clerk and Asst. Engr., on construction of floating drydock, estimating, writing reports, hydraulic dredging, etc.; at present Review Engr. for Tennessee and Virginia; in the interim Designing Engr., G. A. Youngberg and Associates, Inc.; Engr. Robert M. Angas.

Preston, Eugene Fredrick, Detroit, Mich. (Age 36) (Claims RC 1.3 D 1.3) May 1938 to date with U. S. Lighthouse Service on structural and architectural design and field (supervision); previously with Cummins & Barnard, Cons. Power Engrs.; Senior Engr., Port of Detroit Authority; Sub-inspector on dredging, U. S. Engrs., War Dept., Detroit.

Price, Sidney Lester (Junior), Des Moines, Iowa (Age 32) (Claims RC 2.3 D 3.6) May 1934 to date with National Park Service (CCC), as Senior Eng. Foreman, Jun. Engr., and (since June 1938) Chf. of Iowa Central Design Office; previously Field Engr., R. W. Boice Constr. Co.

Price, Thomas Malcolm, Jr. (Junior), Washington, D.C. (Age 32) (Claims RCA 0.3 RCM 2.7) July 1927 to Feb. 1928, July 1930 to Sept. 1936 and April 1937 to date with U. S. Coast & Geodetic Survey, successively as Lightkeeper, Jun. Engr., Aid, Jun. Officer, Jun. Cartographic Engr., and (at present) Asst. Cartographic Engr., Chart Div.

Roberts, Marvin Edward (Junior), Lexington, Tenn. (Age 32) (Claims RC 6.5 D 4.4) Oct. 1936 to date Project Engr., Natchez Trace Forest, Soil Conservation Service, U. S. Dept. of Agriculture; previously Office Engr., LU Div., Resettlement Administration (Soil Conservation Service), Natchez Trace Forest; with CCC, Div. of Forestry, successively as Engr. Foreman, Senior Engr., and Project Supt.

Robertson, Winfred Talmage, Olympia, Wash. (Age 36) (Claims RCA 2.7 RCM 5.0) Dec. 1935 to date Designing Engr., Washington State Dept. of Highways, Bridge Div.; previously Structural Engr. with Geo. M. Rasque, Archt., Spokane; Office Engr., WERA, Dist. 6, Spokane, Wash.

Schmidt, Richard Barnes, Springfield, Ohio. (Age 31) (Claims RC 4.9 D 2.0) 1937 to date with International Harvester Co., on design of tools, etc.; previously Hydr. Engr., U. S. Engr. Corps, Zanesville, Ohio; Civ. Engr., Springfield (Ohio) Conservancy Dist.; Elec. Engr., Hubbard Expedition through West Indies.

Schrewe, Erwin Werner, New York City. (Age 56) (Claims RCA 24.6 RCM 0.0) Sept, 1931 to date Jun. Topographic Draftsman. Dept. of Water Supply, Gas and Electricity, New York City.

SPALDING, ALBERT KINGSLEY (Junior), Baltimore, Md. (Age 32) (Claims RCA 1.7 RCM 3.5) June 1938 to date Designer, The J. E. Greiner Co., Cons. Engrs.; previously Design Engr., The Wichert Continuous Bridge Corporation, Pittsburgh, Pa.; Surveyor and Asst. to Chf. of Party (No. 12), U. S. Coast & Geodetic Survey, New York City.

SWEET, CHARLES LATHAM (Junior), Madera, Calif. (Age 32) (Claims RCA 3.7 RCM 0.5) July 1928 to date with State of California, Div. of Highways and Bridge Dept., as Civ. Eng. Draftsman, Asst. Res. Engr., and (since May 1935) Res. Engr.

THOMAS, HUGUENIN, JR. (Junior), Savannah, Ga. (Age 32) (Claims RCA 5.8 RCM 2.0) Nov. 1928 to date with U. S. Engr. Dept., as Surveyman, Instrumentman, Jun. Engr., until Nov. 1933 Asst. Engr., in charge of Water Resources Sec., then in charge of Plans and Specifications Sec.

THOMPSON, PAUL CHARLES, Albuquerque, N. Mex. (Age 40) (Claims RCA 7.0 RCM 2.5) Sept. 1938 to date Res. Engr., Holway & Neuffer, on sewage-disposal plant (approx. $210,000) construction; previously with U. S. Indian Service, $1^{4}/_{6}$ years as Asst. Engr. and $2^{4}/_{6}$ years Associate Engr.

TORRE, MARIO DE LA (Junior), Convencion, Santander del Norte, Colombia, S.A. (Age 29) (Claims RC 5.6 D 1.0) July 1938 to date with South American Gulf Oil Co., Barranquilla, Colombia, as Locating Engr. and Asst. Res. Engr., San Pablo Camp; previously Const. and Field Engr. Cia. Colombiana de Electricidad.; Engr. Asnazu Gold Dredging Co.

VAN LIEW, ROSCOE EMERSON (Junior), Salt Lake City, Utah. (Age 29) (Claims RC 4.9 D 3.6) Nov. 1938 to date Associate Engr., U. S. Bureau of Reclamation; previously Special Designing Engr., Utah State Engr's Office (1 month); with Lang Co., on various engineering work (about 5 months); with FEA of PW as Clerk-General, Res. Engr. Inspector, Acting Asst. State Office Engr., and Res. Engr. Inspector.

WALKER, WILLIAM SEFTON (Junior), Pittsburgh, Pa. (Age 32) (Claims RCA 4.0 RCM 0.0) Sept. 1937 to date Prof. and Head of Dept. of Structural Eng., Linsly Inst. of Technology, Wheeling, W.Va.; previously with U. S. Engrs., successively as Party Chf. and Plane-Table Topographer; Job Analyst, U. S. Dept. of Labor; Party Chf., CWA; Draftsman, Dept. of Public Works.

WOOD, GEORGE MCCAW (Junior), Rock Island, Ill. (Age 32) (Claims RC 4.7 D 1.7) Oct. 1931 to date with U. S. Engr. Dept., as Student Engr., Jun. Engr., Asst. Engr., acting as Asst. Res. Engr., and (since Sept. 1936) Associate Engr., acting as Res. Engr.

WOODWARD, CHARLES HENRY, Detroit, Mich. (Age 48) (Claims RC 6.7 D 11.5) 1919 to date with City Engr.'s Office, until 1923 as Draftsman, 1923 to 1932 Asst. Sewer Engr., and (since 1932) Asst. Civ. Engr., on design of public and lateral sewers.

WOOLF, ABRAHAM, Detroit, Mich. (Age 31) (Claims RC 1.2 D 2.0) May 1937 to date Draftsman and Designer, Albert Kahn, Inc.; previously Designer and Checker (Structural), A. G. McKee Co., Cleveland, Ohio; Designer and Inspector of Constr. with Mark Linenthal, Boston; Clerk of Works, Commonwealth of Massachusetts, being Engr. Inspector of prison repairs, etc.

YOUNGS, WALTER CHARLES, JR., Austin, Tex. (Age 34) (Claims RCA 8.5 RCM 3.7) Sept. 1930 to date with Texas State Highway Dept., as Chf. Paving Inspector, Concrete Research Engr., and since May 1937 Laboratory Research Engineer, Materials & Tests Div., having supervisory charge of all research sections of Laboratory.

ZAMPELLA, ALBERT ANDREW (Junior), Paterson, N.J. (Age 32) (Claims RCA 9.0 RCM 3.2) Sept. 1938 to date Asst. Civ. Engr., New Jersey State Highway Dept.; previously Asst. Engr., U. S. Engr. Dept.; Engr. and Surveyor, New Jersey Riparian Survey; Engr. and Surveyor, Passaic County Park Comm.; Constr. Engr. with Alfred P. Mott, Inc.

FOR JUNIOR

BELDA, ALEX ANTHONY, Houghton, Mich. (Age 24) (Claims RC 0.7 D 0.3) Nov. 1936 to Sept. 1937 and Feb. 1938 to date with Union Constr. Co., on drafting and estimating, and (since Feb. 1938) Civil Engr.; Nov. 1937 to Jan. 1938 Instructor, Michigan Coll. of Mining and Technology.

BLISS, THOMAS FRANCIS, New York City. (Age 27) Aug. 1937 to date Asst., Madigan-Hyland, Cons. Engrs.; previously with City of Woonsocket, R.I., successively as Bridge Engr., and Asst. Engr., being Asst. to Chf. Engr., Dept. of Public Works.

BOWMAN, JAMES DAVID, Knoxville, Tenn. (Age 26) March 1935 to date with City of Knoxville, successively as Inspector, Rodman, Instrumentman and Draftsman, Material Inspector, and (at present) Asst. Field Engr.

BUEHLER, EDSON JAMES, Columbus, Ohio. (Age 22) 1938 B.C.E. Ohio State Univ.

CARR, JAMES KENNEDY, Redding, Calif. (Age 25) (Claims RC 0.2) April 1936 to date Jun. Engr., U. S. Bureau of Reclamation, Shasta Dam; previously with WPA as Jun. Eng. Project Inspector and Asst. Supervisor, Div. of Operations; Recorder, U. S. Geological Survey, Paynes Creek Quadrangle, topography.

DALY, EDMUND SHAFTESBURY, Knoxville, Tenn. (Age 25) (Claims RCA 0.3 RCM 0.0) Jan. 1935 to date with TVA, as Jun. Eng. Draftsman, Asst. Eng. Draftsman, Eng. Draftsman, and (since May 1936) Jun. Hydr. Engr.; previously Photo-Draftsman, U. S. Forest Service.

DAVIS, PAUL GARRETT, Huntington, W.Va. (Age 28) (Claims RC 2.8 D 0.1) May 1938 to date Supt. and Engr., Beckmeyer-Davis Co.; previously Supt. and Engr., Thompson-King-Tate, Inc., Lexington, Ky.; Engr. and Draftsman, Univ. of Ky.; Res. Engr., J. Stephen Watkins, Lexington, Ky.

DAVY, PHILIP SHERIDAN, La Crosse, Wis. (Age 23) 1937 B.S., and 1938 M.S. in Hydr. San. Eng., Univ. of Wis.; June 1938 to date member of firm, Frank J. Davy & Son, Cons. Engrs.

FLOD, WALFRED ANDREW, Kingsburg, Calif. (Age 23) 1938 B.S. in Civ. Eng., Univ. of Calif.; at present Axeman, U. S. War Dept.

FREEMAN, GEORGE DONALD, Albany, N.Y. (Age 28) June 1934 to date with U. S. Geological Survey, as Jun. Topographic Engr., and (since March 1938) Jun. Hydr. Engr., Water Resources Branch.

JOHNSON, GEORGE DUGAN, York, Pa. (Age 25) 1933 B.A., St. Johns Coll., Annapolis, Md., 1936 B. of Eng., The Johns Hopkins Univ.; Feb. 1937 to date Draftsman, S. Morgan Smith Co., on drafting and hydraulic engineering.

LADER, ISIDORE, New York City. (Age 31) 1938 B.C.E., Coll. of City of N.Y.

LANDER, FRANK TEMPLETON, JR., Austin, Tex. (Age 21) 1938 B.S. in Civ. Eng., The Citadel; Nov. 1938 to date Jun. Hydr. Engr., U. S. Geological Survey; previously Jun. Eng. Aid, Bureau of Public Roads; Laboratory Asst., Testing Laboratory, South Carolina State Highway Dept.

LEVINE, EDWARD, Memphis, Tenn. (Age 22) 1938 B.S. in C.E., Univ. of Tex.; Sept. 1938 to date with Black & Veatch, Kansas City, Mo., as Office Engr. and Instrumentman.

LONG, WILLIAM FREDERICK, Great Falls, Mont. (Age 25) (Claims RCA 2.7 RCM 0.9) June 1935 to date with U. S. Soil Conservation Service, as Jun. Technician, Eng. Aide, Asst. to Project Engr., and (since March 1938) as Project Engr.; previously Constr. Foreman, U. S. Forest Service.

LUDWIG, HARVEY FRED, San Pedro, Calif. (Age 22) 1938 B.S. in Civ. Eng., Univ. of Calif.; at present axeman, U. S. Army Engrs.

OLSEN, GERNER AKTANDER, New Brunswick, N.J. (Age 29) (Claims RC 2.2 D 2.0) Sept. 1938 to date Instructor in Gen. Eng., Rutgers Univ.; previously Instructor in Civ. Eng., Norwich Univ., Northfield, Vt.; Office Mgr., Haakonsen Towing & Transportation Co., New York City.

PAN, CHAO WEN, Ann Arbor, Mich. (Age 26) (1932 B.S. in C.E., Chiaotung Univ. 1937 M.S.E., and 1939 Ph.D., Univ. of Mich.); 1933 to 1935 Eng. Asst., successively with Canton-Hankow Ry. (1 year); and Kwangi Provincial Univ. (1 year); previously Jun. Engr., Dept. of Constr., Kwangsi Provincial Govt.

PETERKA, ALVIN JOSEPH, Norris, Tenn. (Age 28) (Claims RCA 0.9 RCM 0.0) Feb. 1936 to date Jun. Engr., TVA, Hydr. Laboratory, having complete charge of one of hydraulic models of dams under construction, etc., previously Asst. Chf. of Field Party, U. S. Engrs., Zanesville, Ohio; with Geo. E. Barnes, building and testing 15 hydraulic models for the Muskingum flood-control project in Ohio, etc.

PETERSEN, WARREN, Everett, Mass. (Age 27) March 1937 to date with New England Structural Co.; previously with New Hampshire State Highway Dept., on highway drafting, designing and estimating; contracting in Chile, S.A.; Instrumentman, Chf. of Party and Designer for Dickinson & Goodwin, Haverhill, Mass.

POWERS, SPENCER BYRD, Sardis, Miss. (Age 28) (Claims RC 2.0) Feb. 1937 to date Surveyman, Jun. Engr. and Asst. Engr., Sardis Reservoir Project, Vicksburg Engr. Dist.; previously Sub-Surveyman and Surveyman, U. S Waterways Experiment Station.

PRICE, WESTCOTT WILKIN, JR., Big Creek, Calif. (Age 28) (Claims RCA 1.5 RCM 0.0) April 1937 to date Asst. Div. Engr., Southern California Edison Co., Ltd.; previously with Metropolitan Water Dist. of Southern California, as Chainman (also acting as Instrumentman, Draftsman, and Computer), Concrete Inspector, and Senior Inspector, etc.

SCALA, ARTHUR EDWARD, Detroit, Mich. (Age 26) 1938 B.C.E., Univ. of Detroit.

SHAMAMIAN, VINCENT, Albany, N.Y. (Age 22) 1938 B.C.E., Coll. of City of N.Y.; at present Jun. Hydr. Engr., U. S. Geological Survey, Water Resources Branch.

WILLIAMS, ROGER HARGREAVES, Carlsbad, N. Mex. (Age 27) (Claims RCA 0.6 RCM 0.0) June 1938 to date 1st Lieut., Engr. Reserve, U. S. Army, CCC, Ft. Bliss, Tex.; previously with U. S. Engr. Office, as Asst. Chf. of Party, Rodman, Handyman, Sub-Inspector, Student Engr. and Computer.

The Board of Direction will consider the applications in this list not less than thirty days after date of issue.

Men Available

These items are from information furnished by the Engineering Societies Employment Service, with offices in Chicago, New York, and San Francisco. The Service is available to all members of the contributing societies. A complete statement of the procedure, the location of offices, and the fee is to be found on page 11 of the 1938 Year Book of the Society. To expedite publication, notices should be sent direct to the Employment Service, 31 West 39th Street, New York, N.Y. Employers should address replies to the key number, care of the New York Office, unless the word Chicago or San Francisco follows the key number, when it should be sent to the office designated.

CONSTRUCTION

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 25; married; degree of C.E., Pennsylvania Military College, 1934; 4 years experience in field work on construction of sewers, railroads, highways, tunnels, and steel and reinforced concrete structures. Location immaterial. Available immediately. C-470.

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; graduate; New York Professional Engineers' License; 32; married; 8 years construction, design, estimating, planning with general contractors on river tunnels, marine construction, building construction. Desires position in any of these fields. Employed on river tunnel construction but available on reasonable notice. Location immaterial. C-474.

CONCRETE AND SOILS ENGINEER; Assoc. M. Am. Soc. C.E.; 31; married; 8 years as concrete and soils engineer in charge of testing laboratory and field inspection and construction; a total of 11 years construction. C-477.

STRUCTURAL-CONSTRUCTION ENGINEER; M. Am. Soc. C.E.; B.C.E., University of Michigan; registered professional engineer, Pennsylvania;